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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-13348# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

IN REFERENCE TO A NONLINEAR THEORY OF AERODYNAMIC STABILITY

V. V. Struminskiy 5 May 1964 8 p Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 151, no. 5, 1963 p 1046–1049

(FTD-MT-64-07; AD-602581)

The method of successive approximations was applied in the investigation of the problem of aerodynamic stability. The first order of approximations coincides with the usual linear theory, and a recurrence system of ordinary differential equations is obtained for subsequent approximations. It is shown that the boundary of stability and the character of perturbation changes with time, for successive approximations are determined by the linear approximation. Consequently, laminar flows which are stable by the linear theory will also be stable by the nonlinear theory. G.G.

N65-13544*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

APPLICATION OF GENERALIZED NEWTONIAN THEORY TO THREE-DIMENSIONAL SHARP-NOSE SHOCK-DETACHED BODIES AT MACH 6 FOR ANGLES OF ATTACK UP TO 25°

George C. Ashby, Jr. and Theodore J. Goldberg Washington, NASA, Jan. 1965 43 p refs

(NASA-TN-D-2550) OTS: HC $2.00/MF $0.50

Pressure distributions were obtained for three-dimensional sharp-nose parabolic-arc, circular-arc, and conical bodies having an apex half-angle greater than that for shock detachment (aerodynamically blunt bodies) at Mach 6 for angles-of-attack up to 25° The maximum pressure coefficient was found to increase continuously from the shock-attachment value to the stagnation value behind a normal shock between apex deflection angles of 56° and 61°, 65°, or 69° depending on the body contour. The data for contoured bodies are correlated very well by the generalized form of Newtonian theory. In addition, at all angles-of-attack for all aerodynamically blunt bodies having curved surfaces, the agreement between the generalized form of the Newtonian theory and the measured values of pressure coefficient was reasonably good for surface-deflection angles above 30°. This theory can be used to predict pressures on most three-dimensional bodies by the methods shown. Author

N65-13878 Aeronautical Research Council (Gt. Brit.)

A STUDY OF SLENDER, CAMBERED, CONICAL WINGS BY AN ELECTRICAL RESISTANCE NETWORK

H. S. Ward (Birmingham U.) London, HMSO, 1964 11 p refs (ARC-R&M-3369) HMSO: 5s

An electrical resistance network for solving the Laplacian field equation has been used to determine the attached-flow incidence of thin slender wings with different forms of camber. This incidence was found by applying the wing boundary condition exactly at the wing's surface. The lift and induced drag have not been evaluated for the wings studied. Comparison of the stream function obtained from an experiment with that of a known theoretical solution has shown that there should be no difficulty in determining the loading of such wings at the attached-flow incidence. Author

N65-13880 Aeronautical Research Council (Gt. Brit.)

SOME TESTS ON HIGH-REACTION COMPRESSOR BLADING

R. C. Turner and R. A. Burrows London, HMSO, 1964 20 p refs

(ARC-R&M-3380) HMSO: 8s 6d

Two sets of blading, designed for 120% reaction, and for flow coefficients of 0.667 and 1.0, respectively, have been tested in a low-speed compressor. The performances were compared with those of corresponding sets of 50%-reaction blading and with predictions based on simple theoretical methods. The high-reaction bladings both gave efficiencies which were lower by amounts broadly in line with the predictions. The work-done factors were also appreciably lower. The lower flow-coefficient blading showed a significant advantage in pressure rise over its 50%-reaction counterpart, with about the same surge flow, while the high-flow blading was deficient in pressure rise but had a considerably wider surge margin. Author

N65-13961*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A NUMERICAL METHOD FOR CALCULATING THE FLAT-PLATE PRESSURE DISTRIBUTIONS ON SUPERSONIC WINGS OF ARBITRARY PLANFORM
Wilbur D. Middleton and Harry W. Carlson Washington, NASA, Jan. 1965 25 p refs
(NASA-TN-D-2570) OTS: HC $1.00/MF $0.50

This report describes a numerical method based on linearized theory for calculating the flat-plate lifting-pressure distributions on supersonic wings of arbitrary planform, and presents examples of its usage. The precision of the method is shown by comparisons of pressure distributions and force coefficients calculated from the numerical method with those obtained from established analytical solutions for straight-line leading- and trailing-edge wings. Several examples of the use of the numerical method to estimate the aerodynamic characteristics of curved or cranked leading-edge wings are presented to illustrate the flexibility of the method. Author

N65-13966 Aeronautical Research Council (Gt. Brit.)
A COLLECTION OF DATA ON THE LIFT-DEPENDENT DRAG OF UNCAMBERED SLENDER WINGS AT SUPERSONIC SPEEDS
A. L. Courtney London, HMSO, 1964 9 p refs Supersedes RAE-TN-AERO-2696, and ARC-22371
(ARC-CP-757; RAE-TN-AERO-2696; ARC-22371) HMSO: 2s 6d

Experimental data are presented on the lift-dependent drag of uncambered slender wings at supersonic speeds. It is shown that the values of the overall lift-dependent drag factor K collapse into a single curve, for a wide range of planform shapes and slenderness parameters, if K is plotted against

$$1/2 \cdot \beta s/l.$$

The implications of this dependence of K on p are briefly discussed. Author

N65-13978 Aeronautical Research Council (Gt. Brit.)
TABLES OF THE FUNCTION $x^n K_n(x)/2^{n-1}(n-1)!$ FOR USE AS CUMULATIVE FREQUENCY DISTRIBUTIONS
N. I. Bullen and Elizabeth Busby London, HMSO, 1964 37 p refs Supersedes RAE-TN-STRUCT-346, ARC-25922
(ARC-CP-765; RAE-TN-STRUCT-346; ARC-25922) HMSO: 7s

The function $x^n K_n(x)/2^{n-1}(n-1)!$ is useful for fitting to observed cumulative frequency distributions of gust loads on aircraft. This paper makes available tables of this function and describes briefly the methods by which they were computed and prepared. The function and its logarithm are tabulated for the following values:

$$x = 0.1(0.1)20, \text{ and}$$
$$n = 1/2(1/2)6(1)10.$$

Author

N65-14052# Itek Corp., Palo Alto, Calif. Vidya Div.
THEORETICAL AERODYNAMICS OF FLEXIBLE WINGS AT LOW SPEEDS. PART III: APPROXIMATE RESULTS FOR WINGS OF LARGE ASPECT RATIO
A. R. Kriebel and J. N. Nielsen 1 Jul. 1964 43 p refs
(Contract Nonr-3728(00))
(VIDYA-146; AD-606059)

On the basis of strip theory neglecting induced downwash, an analysis was made to obtain the geometric and aerodynamic characteristics of a number of flexible wings. The wings have leading edges that lie in a plane and utilize a trailing-edge cable which can have curvatures in both horizontal and vertical planes. Analytical solutions were found for wings with leading edges of different shape that satisfy both the equation of static equilibrium for the trailing-edge cable as well as flexible airfoil theory for the strips. The wings are designed for a specific design angle-of-attack with a value of the chordwise tension parameter chosen to avoid camber flutter. A number of calculative cases are presented to show how the wing characteristics vary with three basic parameters used in the theory. An exploratory attempt to include induced downwash in the calculations using Prandtl-swept lifting line was not successful because of singularities in the induced downwash. A combination of the Weissinger and Prandtl methods was partially successful but of limited accuracy. Author

N65-14094# California Inst. of Tech., Pasadena. Hydrodynamics Lab.
SUPERVENTILATED FLOW PAST DELTA WINGS
Taras Kiceniuk Jul. 1964 46 p refs
(Contract N123(60530)-34767A)
(E-101.5; AD-607974)

Measurements of lift, drag, pitching moment, and pressure distributions were made on a family of simple flat delta shapes of varying apex angle. Also, several other configurations were tested, including a diamond planform, reverse delta, and a delta with a 90-degree bottom. All were without camber and were tested with no yaw angle. The results of the force measurements on the superventilated delta-wing models with apex angles varying from 10 to 90 degrees are presented in figures in which the lift coefficient, the drag coefficient, and the center of pressure location are plotted as functions of the model cavitation number. The effect of apex angle on the force and moment coefficients at a constant value of cavitation number and angle-of-attack is presented in a cross plot. The effects of model dead rise and planform, model inversion, model reversal, and angle-of-attack are also discussed. D.S.G.

N65-14102# ARO, Inc., Arnold Air Force Station, Tenn.
COMPARISONS OF FREE-FLIGHT AND WIND TUNNEL DATA ON SLENDER CONES
B. J. Griffith and Leo J. Siler Arnold Eng. Develop. Center, Dec. 1964 30 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-272; AD-453414)

High-Mach-number wind-tunnel drag, lift, moment, and heat-transfer data from sting-mounted models are compared with available free-flight data. The resulting comparisons show that there is an apparent lack of support interference effects on forebody flow fields of slender cones, and that the so-called real gas effects on the observed data are insignificant at velocities up to 18 000 fps. Author

N65-14132# Princeton U., N.J.
TESTS OF A HAMILTON STANDARD FOUR-WAY, 21-INCH-DIAMETER MODEL PROPELLER EMPLOYING THE U.S. NAVY AIRBORNE MODEL TEST FACILITY
John W. Olcott Apr. 1964 86 p refs
(Contract Nonr-1858(14))
(Rept.-675; AD-603791)

A 1/9th scale model of one of the initial XC-142 VTOL propeller designs was tested in free air conditions through 90° of inflow angle. Both the aerodynamic and structural tests are described, and data are presented. Thrust and torque values obtained experimentally agreed with analytically determined values for all inflow angles through 90°. Propeller normal force was slightly higher than predicted. The general quality of the structural data was excellent. Author

N65-14149# Bell Aerosystems Co., Buffalo, N.Y.
NONLINEAR THERMOELASTIC EFFECTS ON HYPERSONIC STABILITY AND CONTROL. PART I, VOLUME 2: AERODYNAMICS
James R. Batt Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Sep. 1964 130 p
(Contract AF 33(657)-7486)
(FDL-TDR-64-16, Pt. I, Vol. 2; AD-453450)

The curves presented in this volume are to be used to obtain aerodynamic influence coefficient matrices for slender two-dimensional airfoils in hypersonic inviscid flow. Influence coefficients are presented for ten airfoil shapes as a function of thickness ratio, Mach number, and geometric angle-of-attack. Author

N65-14194 Aeronautical Research Council (Gt. Brit.)
ON LIFTING BODIES WHICH CONTAIN TWO-DIMENSIONAL SUPERSONIC FLOWS
L. H. Townend London, Min. of Aviation, 1964 46 p refs Supersedes RAE-AERO-2675, ARC-25277; see X64-11714 (ARC-R&M-3383; RAE-AERO-2675; ARC-25277) HMSO: 18s 6d

Discussed are the design principles of three-dimensional surfaces which can produce two-dimensional, centered compression waves and which are derived from the Nonweiler wing. A study is made of the efficiencies (i.e., of the pressure recoveries) of various multishock and isentropic compression flows, and of the lateral slenderness of related caret bodies. For bodies producing isentropic compression, spanwise pressure distributions are shown to depend on anhedral and planform, and it is noted that such bodies should be of use in research on three-dimensional boundary layers. It is shown that multiwave and isentropic compression surfaces may be used as intakes (or isentropic bodies as nozzles), and that these can be used as components in the design of configurations, beneath which lifting and propulsive flows can be wholly two dimensional. Various models are proposed for inclusion in current wind-tunnel programs. Author

N65-14195 Aeronautical Research Council (Gt. Brit.)
ON THE VARIATION OF PROFILE DRAG COEFFICIENT BELOW THE CRITICAL MACH NUMBER
J. F. Nash, T. H. Moulden, and J. Osborne London, Min. of Aviation, 1964 16 p refs Supersedes NPL-AERO-1084, ARC-25349; see X64-15071
(ARC-CP-758; NPL-AERO-1084; ARC-25349) HMSO: 3s 6d

An expression is given for the estimation of the drag coefficient of two-dimensional aerofoil sections at subsonic speeds up to the critical Mach number. Calculations for the 12% thick R.A.E.103 section show a rise of about 10% in the value of the profile drag coefficient between low speeds and the critical Mach number, for the same Reynolds number and transition position. The predicted drag variation is in good agreement with measurement. Author

N65-14220# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
AERODYNAMIC CHARACTERISTICS OF RING WINGS A Bibliography, 1950 – Jun. 1964
John E. Terry Sep. 1964 38 p refs
(RSIC-285; AD-452725)

The references pertain primarily to the following aerodynamic information on ring wings, also known as annular wings or circular wings: calculation of circumferential velocity and pressure distribution; studies on flow separation phenomena at the wing leading and trailing edges; measurement of lift, drag and pitching moment; application of linearized theory to subsonic and supersonic gas flow; theory and measurement of vortex drag; measurement of three-dimensional turbulent boundary layer; determination of flutter using linearized equations; theory of stationary inviscid, incompressible flow around the wing; studies on drag reduction; studies on interference effects of an axisymmetric fuselage or a strut on wing pressure distributions; wind-tunnel tests of wings with and without a fuselage; and determination of optimum shape. Author

N65-14323# Grumman Aircraft Engineering Corp., Bethpage, N.Y.
HEAT TRANSFER MEASUREMENTS AT MACH 8 ON AN AERODYNAMICALLY CONTROLLABLE WINGED REENTRY CONFIGURATION
Lawrence Meckler Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Sep. 1964 438 p refs
(Contract AF 33(616)-8130)
(FDL-TDR-64-142; AD-608830)

Heat transfer data were obtained at Mach 8 for a winged reentry configuration with several types of aerodynamic controls. The basic model consisted of a clipped delta wing with an overslung cone–cylinder body. Most of the tests were conducted with partial span trailing edge flaps. The effects of tip fins, a hemisphere–cylinder body, a full span trailing edge flap, and a full span, plug-type, trailing edge spoiler were also investigated. The partial span flap deflection were varied between ±39 degrees in an angle-of-attack range of ± 20 degrees. Selected configurations were used to examine the angle-of-attack ranges of −30 degrees to −50 degrees and +30 degrees to + 50 degrees. The major portion of the program was conducted at a unit test section Reynolds number of 3.3×10^6/ft with limited comparative testing being done at a unit test section Reynolds number of 1.1×10^6/ft. Author

N65-14325# Toronto U. (Canada). Inst. of Aerospace Studies
PERFORMANCE, OPERATION, AND USE OF LOW-ASPECT-RATIO JET-FLAPPED WINGS
G. K. Korbacher Ft. Eustis, Va., Army Transportation Res. Command, Aug. 1964 48 p refs
(Grant DA-AMC-44-177-63-G9)
(UTIAS-97; TRECOM-TR-64-38)

The characteristics of a jet-flapped wing of aspect ratio 6 are presented, discussed, and evaluated for STOL application. Again, as for high-aspect-ratio (AR = 20) jet-flapped wings, a range for the most economical jet-flap operation is well defined. The angle-of-attack as an efficient means of lift production loses its usefulness with low-aspect-ratio jet-flapped wings, whereas the optimum jet-deflection angle seems hardly affected ($\theta \simeq 55°$). A most efficient jet-flap application for STOL calls for a complete integration of the lifting and propulsive systems. In the range of most economical jet-flap operation, semiempirical relationships predict parameter changes accurately enough for practical purposes. Author

N65-14399# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN APPROXIMATION OF AERODYNAMIC COEFFICIENTS OF THIN BODIES OF REVOLUTION MOVING AT VERY GREAT SUPERSONIC SPEEDS
N. F. Krasnov 9 Mar. 1964 31 p refs Transl. into ENGLISH from Tr., Vyssheye Tekhn. Uchilishche Imeni Baumana (Moscow), no. 32, 1955 p 75–99
(FTD-MT-63-169; AD-605587) OTS: $0.75

The coefficient of pressure on a thin cone at very high free-stream velocities is determined on the basis of a linearized equation for speed potential. It is assumed that the flow of gas at very great speeds near a thin solid of revolution with an arbitrary generatrix possesses the same properties of "Newton flow" as in the case of a thin cone, and an expression for the pressure coefficient is derived. An approximation method is worked out for the magnitude of the wave-drag coefficient, and an example of an application to a specific generatrix is given. Methods are worked out for the approximate evaluation of the magnitude of the lift coefficient and for the magnitude approximation of the coefficient of the center of pressure; the latter method is applied in an example. D.E.W.

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-13574*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL-WALL EFFECTS AND SCALE EFFECTS ON A VTOL CONFIGURATION WITH A FAN MOUNTED IN THE FUSELAGE
Edwin E. Davenport and Richard E. Kuhn Washington, NASA, Jan. 1965 99 p refs
(NASA-TN-D-2560) OTS: HC $3.00/MF $0.75

An investigation of the aerodynamic characteristics of a model of a VTOL configuration with a lifting fan mounted in the fuselage was conducted to determine the effects of scale and the effects of tunnel walls on the characteristics of this configuration, which had previously been investigated at full scale. The results of the investigation indicate that significant wall effects were encountered with the model in the small test section and with the full-scale configuration. After correcting both model and full-scale data for wall effects and after considering differences in vane characteristics, the data with exit vanes deflected were in good agreement. However, with the vanes undeflected, significant differences between the model and full-scale data remain. These differences were found to be largely due to differences in the suction pressures induced on the bottom of the fuselage behind and beside the jet; and, to a smaller extent, to differences in the model and full-scale power-off characteristics; and to differences in the inlet mass flow for the model and full-scale configuration. A large part of the wing lift induced on the model and the full-scale configuration at zero angle-of-attack was found to be due to the wall-induced upwash field in which the wing was operating. Author

N65-13984# California U., Berkeley. Inst. of Engineering Research
RESEARCH ON ANNULAR NOZZLE TYPE GROUND EFFECT MACHINE OPERATING OVER WATER. PRELIMINARY STUDY OF AIR FLOW PATTERNS. APPENDIX: DIMENSIONAL ANALYSIS
J. D. Cumming and Gunnar Sigurdsson May 1964 48 p refs *Its* Ser. 187, Issue 6
(Contract Nonr-222(71))
(AD-605170)

As a result of experimentation in a towing tank, it is stated that a GEM hovering over water generates a depression in the water surface and may hover above or below the mean water level. During operation, the pressure under the base is a function of jet thickness, clearance height, momentum, angle of inclination and the angle at which it strikes the water surface. During forward motion, the airflow assumed different geometries around the nozzle, and various wave patterns were formed, depending on the nozzle velocity across the water. D.E.W.

N65-14042# John Hopkins U., Baltimore, Md. Lab. of Astrophysics and Physical Meteorology
BAL-AST: BALLOON-ASTRONOMY PROGRAM AT THE JOHNS HOPKINS UNIVERSITY Final Report
John Strong 1 Aug. 1964 74 p refs
(Contract AF 19(628)-202)
(AFCRL-64-825; AD-608706)

Water in the atmosphere of Venus, discovered by Moore and Ross in November 1959 with a ballon–telescope system, was confirmed and measured far more precisely in February 1964 with an automatic unmanned system. These scientific results are presented. The original telescope system, and the automatic one into which it was transformed are described. The optical and instrumental developments that have made automatic balloon astronomy feasible are described. A new balloon-launching procedure is described. Work planned for the future is mentioned, including a ground-based use for the new telescope. Author

N65-14077# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
HELICOPTER DOWNWASH BLAST EFFECTS STUDY
G. W. Leese Oct. 1964 44 p
(TR-3-664; AD-452177)

Field tests were conducted with operational helicopters to determine downwash velocity profiles. In addition, tests utilizing scale-model rotor blades were made over wet and dry sands and a dry lean clay, and over a chemically stabilized soil, plastic-impregnated soils, and lightweight ground covers (membranes) to determine (1) the model-scale velocity profiles and air velocities at the ground surface required to dislodge and move particles of various types of soil, (2) the size of soil area requiring protection for various VTOL aircraft, and (3) the effectiveness of membranes and soil stabilization in preventing dust-cloud formation. Author

N65-14181# Boeing Co., Seattle, Wash.
SST HANDLING CHARACTERISTICS DURING APPROACH AND LANDING FLIGHT REGIMES, VOLUME II Quarterly Progress Report No. 4, 1 Apr. 1964–30 Jun. 1964
G. R. Gannett et al 1 Jul. 1964 506 p refs Work performed in conjunction with North Am. Aviation, Inc.
(Contract AF 33(657)-11461)
(BNJV-A-Q4; AD-449481)

Described are the supplemental results of the first 720 test landings performed under Exhibit A. The form of the analysis is Pearson Type III probability curves and frequency histograms for applicable parameters at touchdown and the middle marker and threshold, respectively. A listing of the raw data, from which all the analysis was made, is also presented

and numbered sequentially. A sampling of flight trajectories in the X-Z and X-Y planes is also included. Only 1 out of every 10 flights was sampled. Author

N65-14295# College of Aeronautics, Cranfield (Gt. Brit.)
THE TEACHING OF AIRCRAFT DESIGN
A. F. Newell and D. Howe Mar. 1964 18 p ref
(CoA-AERO-162)

The course in aircraft design is at postgraduate level and is of two years' duration. In the first year, the students are given three exercises in component design which aim to teach a logical approach and the fundamentals of the subject. During the second year, each student works as a member of a team engaged in the design of a complete aircraft, which is chosen to be of a type currently being investigated by industry. The project aircraft invariably incorporates experimental features, and the design work is therefore of the nature of research. Author

N65-14321# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
SIMULATOR EVALUATION OF AIRPLANE LONGITUDINAL RESPONSES FOR THE INSTRUMENT-LANDING APPROACH
F. D. Newell Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Oct. 1964 61 p
(Contract AF 33(657)-7442)
(TB-1630-F-2; FDL-TDR-64-84; AD-608847)

A precision-instrument maneuver including holding heading straight and level, climbing and descending, and climbing and descending turns was flown in a fixed-base simulator for many different combinations of drag, lift, and pitch characteristics. Two pilots evaluated the effects of these characteristics on their ability to perform an instrument landing approach in a single-pilot, high-performance airplane. The results will guide further work. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-13390# General Electric Co., King of Prussia, Pa. Space Sciences Lab.
THE APPLICATION OF ALKALI METAL VAPOR SYSTEMS TO MHD SPACE POWER GENERATORS
Bernard Hoffman and Frederick Shair *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Dec. 1964 p 316–352 refs (See N65-13376 04-34) OTS: $7.00
(Contract AF 33(657)-8298)

This report describes a theoretical and applied research program directed toward prolonging the lifetime of magnetohydrodynamic (MHD) energy converters by reducing the necessary operating temperatures to the range 1000° to 2000° K. The process of interest is the use of the magnetically induced electric field in the MHD generator for electrical breakdown of appropriate working fluids. Work was directed toward the use of alkali metals for Rankine (vapor) cycles (although the results are applicable to Brayton cycles with certain nuclear reactors) and alkali metal seeded noble gases for studying the basic parameters of the breakdown. Author

N65-13391# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANALYSIS OF THE ACCELERATION OF LITHIUM IN A TWO-PHASE NOZZLE
David G. Elliott *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Dec. 1964 p 353–380 refs (See N65-13376 04-34) OTS: $7.00
(Contract NAS7-100)

To generate electric power magnetohydrodynamically from a liquid metal in a closed cycle, the metal must first be accelerated to several hundred feet per second in a two-phase nozzle. This paper presents results of calculations on the acceleration of lithium by cesium vapor in a two-phase nozzle. The calculations indicate that 85% to 90% of isentropic velocity can readily be attained, and this conclusion is supported by experiments on the acceleration of water by nitrogen and by Freon. Author

N65-13507# Joint Publications Research Service, Washington, D.C.
DIRECT CONVERSION OF ELECTRICITY
V. A. Kirillin 22 Dec. 1964 6 p Transl. into ENGLISH from Izv. (Moscow), no. 76, 29 Mar. 1964 p 5
(JPRS-27939; TT-64-51981) OTS: $1.00

The principles of magnetohydrodynamic power generation are discussed. The difficulties of maintaining a constant plasma for electric current generation in a thermal electric power station are related to the high temperatures required to maintain the plasma. The utilization of the relatively low-temperature (1500° C) waste combustion products from the MHD-generator for steam generation in an ordinary thermal power station results in higher total efficiency. This two-circuit system of a combined power station uses the combustion products also for heating of another gas which circulates through a closed circuit of the MHD-generator and makes it possible to lower the operating temperature of the MHD-generator by 500° C. This permits a wider selection range of operating materials for power generation. G.G.

N65-13526*# Yardney Electric Corp., New York, N.Y.
INVESTIGATION AND IMPROVEMENT OF ZINC ELECTRODES FOR ELECTROCHEMICAL CELLS Quarterly Report No. 1, Jul.–Sep. 1964
Z. O. J. Stachurski and G. A. Dalin [1964] 27 p
(Contract NAS5-3873)
(NASA-CR-59945) OTS: HC $2.00/MF $0.50

In the study of zinc electrodeposition, four distinct types of zinc plating were obtained. Smooth plating (dense deposits with no pores visible even at 1000x) is obtained when no concentration polarization occurs. The second type is a light sponge or foam of very fine porosity (porosity invisible at 100x); it is produced on stationary electrodes in the same range of overpotentials (20 mV) and concentrations in which smooth plating takes place on rotating electrodes, suggesting that concentration polarization is involved. The third type of deposit is dendritic (hexagonal elongated crystals with branches visible at 100x); this deposit is formed at overpotentials of 100 mV or higher under conditions such that unrestricted growth is feasible. Where a membrane restricts growth and

the overpotential is also at 100 mV or higher, the fourth type of deposit, a heavy sponge, results. The effects of the presence of a separator, the absorption of the electrolyte on the separator, and the amount of hydrogen evolution on zinc deposition are discussed. D.S.G.

N65-13539*# Electro-Optical Systems, Inc., Pasadena, Calif. Advanced Power Systems Div.
VAPOR THERMIONIC CONVERTERS Fifth Monthly Progress Report, 19 Mar.–19 Apr. 1963
A. O. Jensen 8 May 1963 8 p
(Contract NAS3-2529)
(NASA-CR-59700; EOS-3410-ML-5) OTS: HC $1.00/MF $0.50

Identification of the crystal orientation associated with the various grain patterns of molybdenum bar and plate subjected to various process times and temperatures is being accomplished by indexing with a diamond point the grains with various patterns of interest. The indexed grains are then analyzed by X-ray diffraction techniques, and a comparison is made of a plate stock molybdenum sample and bar stock. Vehicles for long-time grain growth studies of molybdenum in cesium vapor are discussed, and modifications needed to shield the electron emission microscope from stray magnetic fields are considered. E.C.

N65-13540*# Electro-Optical Systems, Inc., Pasadena, Calif.
VAPOR THERMIONIC CONVERTERS Sixth Monthly Progress Report, 19 Apr.–19 May 1963
A. O. Jensen 17 Jun. 1963 11 p
(Contract NAS3-2529)
(NASA-CR-59701; EOS-3410-ML-6) OTS: HC $1.00/MF $0.50

Experimental results were obtained on the electron emission from cesiated molybdenum bar stock. The temperature range of the emitter was approximately 600° to 1500° C, and the cesium reservoir temperature was varied from 290° C to 350° C. Emission densities, work functions, and time-at-temperature effects were measured. A sample of molybdenum bar stock was placed in the electron microscope and operated at 1500° C for 121 hours, with no preliminary heat treatment. A selection of photographs of the electron emission image at various times during the run is shown, and conclusions are drawn. Two samples of vapor-deposited tungsten, one on a copper plate and one on a molybdenum rod end, were scanned by an X-ray diffractometer. The preferential orientations of various planes were tabulated. There is a preferential orientation of (110) and (310) in the tungsten-on-copper specimen and a very strong preferred orientation of the (200) plane (the cube face) in the tungsten-on-molybdenum specimen. D.E.W.

N65-13560*# Martin Co., Baltimore, Md.
ACCEPTANCE TESTING PHASE ONE OF NASA NICKEL-CADMIUM BATTERY TEST PROJECT Final Report
Oct. 1963 51 p
(Contract NAS5-3027)
(NASA-CR-59663; ER-13179) OTS: HC $3.00/MF $0.50

Acceptance tests were conducted to define the capacity of the cells and to eliminate those cells with marked variant electrical properties or defects such as leaks and internal shorts. The average ampere-hour capacity of all 133 initially accepted cells was 6.340 amp-hr. After rejection of 15 of these cells on the basis of capacity deviation, the average decreased to 6.329 amp-hr. Average terminal pressures and terminal voltages following the third charge of the charge–stand–discharge cycling during capacity test were also determined. Of the 239 cells received, 121 were rejected; 85 were rejected for overvoltage, 15 for capacity deviation, 6 for caustic leak, and the others for internal short, blocked gauge, or combinations of defects. D.S.G.

N65-13561*# Martin Co., Baltimore, Md.
ACCEPTANCE TESTING, PHASE ONE OF NASA NICKEL-CADMIUM BATTERY TEST PROJECT, SUPPLEMENT NO. 1 Final Report
Nov. 1963 8 p
(Contract NAS5-3027)
(NASA-CR-59664; ER-13219, Suppl. 1) OTS: HC $1.00/MF $0.50

Acceptance test data on 13 pressure-transducer-equipped cells are given. Also included is a battery parameter list, by cell, of 12 batteries to be used in the cycling test portion of the battery test project. R.L.K.

N65-13846*# Union Carbide Corp., Parma, Ohio. Parma Research Lab.
STUDY PROGRAM TO IMPROVE FUEL CELL PERFORMANCE BY PULSING TECHNIQUES Quarterly Report, Period Ending Nov. 30, 1964
M. L. Kronenberg [1964] 22 p refs
(Contract NAS3-6460)
(NASA-CR-54249) OTS: HC $1.00/MF $0.50

Under certain conditions heavy discharge pulses significantly improve the performance level of fuel cells. This investigation is concerned with defining the conditions under which pulsing improves fuel cell performance. How this "pulsing effect" depends on such factors as nature of the catalyst, catalyst concentration, and temperature, as well as its effect on electrode life, are studied. Author

N65-13847*# Pratt and Whitney Aircraft, East Hartford, Conn.
ANALYTICAL STUDY OF LIQUID METAL CONDENSERS. VOLUME I: DESIGN STUDY Topical Report, 1 Jun. – 1 Dec. 1963
H. L. Hess, H. R. Kunz, and S. S. Wyde 15 Jul. 1964 235 p refs
(Contract NAS3-2335)
(NASA-CR-54224; PWA-2320, Vol. I) OTS: HC $6.00/MF $1.50

Based on considerations of heat transfer, fluid mechanics, structural integrity, fabrication and sealing, and systems integration, procedures were worked out for the design of an indirect condenser for a one-megawatt (electric) nuclear Rankine-cycle space powerplant. A computer program was written to facilitate calculations for the most promising shell-and-tube configurations. The optimum condenser consisted of a constant-diameter shell-and-tube design operating in parallel with a number of similar units in such a manner that each condenser is associated with a separate radiator segment. Considering a 16-segment radiator using NaK as the coolant, the condensers consisted of 91 tubes of 0.375-inch o.d. and 12.0-inch length, inside of shells of 8.17 inches o.d. The total weight was 740 pounds. Columbium–1% zirconium was selected as the construction material because of the desired 10 000-hour life. All joints should be welded under an inert gas cover using tungsten electrodes. In addition to being welded, all tube-to-tube sheet joints should be diffusion-bonded. R.L.K.

N65-13851# Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
ELECTROLYTIC DISSOLVER FOR POWER FUELS
Vincent P. Caracciolo and Albert A. Kishbaugh Oct. 1964 34 p refs
(Contract AT(07-2)-1)
(DP-896) OTS: $2.00

A 5000-A electrolytic dissolver was built and successfully operated with unirradiated fuel assemblies. Practical rates of dissolution were obtained with fuel assemblies of UO_2 clad in stainless steel or Zircaloy, with UO_2–stainless-steel cermet plates clad in stainless steel, and with stainless-steel-clad, sodium-bonded uranium rods. Author

N65-13866*# General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
FLUID AMPLIFIER SYMBOLS, NOMENCLATURE, AND SPECIFICATION
R. A. Raber and J. N. Shinn Washington, NASA, Jan. 1965 43 p
(Contract NAS8-5408)
(NASA-CR-147) OTS: HC $2.00/MF $0.50

This manual was prepared to provide standardization in the no-moving-part fluid amplifier field for NASA use. Terminology is presented with the aid of diagrams. Nomenclature for the more commonly used quantities is listed with two sets of units, the standard ones now in use, and the International System of Units which NASA is evaluating and may adopt. Nomenclature for the beam deflector proportional amplifier and the wall attachment digital amplifier is identified on sketches. Parameters are defined, and schematics for the more common proportional digital and general circuits are illustrated. Examples of suggested arrangements for displaying characteristic curves of fluid amplifiers are shown. A suggested format of a specification sheet for fluid amplifiers is illustrated. R.L.K.

N65-13988# Mallory (P.R.) and Co., Inc., Burlington, Mass. Lab. for Physical Science
CELL EQUALIZATION TECHNIQUES Quarterly Technical Progress Report, 1 Jul. 1964–1 Oct. 1964
F. J. Cocca 15 Oct. 1964 16 p
(Contract AF 33(615)-1342)
(AD-607296)

Hermetically sealed Ni-Cd cells were cycled for the first time with stabistor charge control. The capacity range used was 5 to 20 A-h. Four charge control circuits BCC-9, BCC-10, BCC-11, and BCC-12 were cycled with and without stabistor protection. In all the circuits the stabistors were effective in clamping cell voltages and minimizing gassing. In BCC-11, 20 AH Ni-Cd cells were cycled and the stabistors were effective in preventing catastrophic failures. Some antireversal studies were conducted during this period. Initial results indicate that antireversal diodes are partially successful in preventing gassing during cell reversal. The data suggest the use of a larger antireversal diode for adequate protection. Author

N65-13990# Radio Corp. of America, Lancaster, Pa. Thermionic Converter Engineering
THE DEVELOPMENT OF A LOW TEMPERATURE CYLINDRICAL THERMIONIC GENERATOR Quarterly Technical Report, 16 Jun.–15 Sep. 1964
W. B. Hall 30 Sep. 1964 45 p
(Contract AF 33(615)-1547)
(QTR-2; AD-607086)

A converter Type A-1198B remained on life test for 4470 hr at approximately 150% of output power rating with a constant level of 63 W. The three-converter module A-1274 was operated over an emitter temperature range of 1200° to 1350° C for approximately 30 hr with a maximum output of 76 W. Fabrication of two improved type A-1274 modules was completed. Preliminary tests of these modules indicated the need for modifications of the end-cap diaphragm, ceramic-to-metal seal, and radiator fin configuration. Two A-1194E converter test vehicles were built to evaluate nickel and molybdenum matrix impregnated with tungsten trioxide as collector materials. Complete data were taken on the nickel collector for use as a control unit. The molybdenum matrix collector impregnated with tungsten trioxide is currently being evaluated. A new type of heater assembly was used in the converter employing the molybdenum matrix collector. Author

N65-14054# Cook Electric Co., Dayton, Ohio. Inland Testing Labs.
ALKALINE CELL EVALUATION AND ANALYSIS Quarterly Technical Progress Report, 15 Aug.–15 Nov. 1964
E. A. Roeger, Jr. and P. R. Voyentzie 1 Dec. 1964 26 p
(Contract AF 33(615)-1580)
(QTPR-2; AD-608666)

This report covers a secondary battery-applied research and failure analysis program. The purpose of this program is to determine the actual failure mechanism of all components of alkaline storage batteries, and to determine techniques and materials to prevent these premature failures, and to devise analytical methods for predicting the life of cells under any environmental condition. The program is also concerned with determining methods for gas suppression and the hermetic sealing of alkaline cells. The program has been separated into five different parts: (1) Investigation of Seals, (2) Investigation of Cell Operating Variables, (3) Investigation of Memory Effects, (4) Investigation of Variable, and (5) Evaluation of New or Improved Cells. Author

N65-14057# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Space and Defense Sciences Dept.
DESIGN OF HYDROGEN-OXYGEN CAPILLARY TYPE FUEL CELL Quarterly Technical Progress Report, 1 Aug. – 31 Oct. 1964
D. R. Bruesewitz, D. R. Desai, J. C. Prestridge, and T. F. Egan 16 Nov. 1964 19 p
(Contract AF 33(615)-1185)
(QTPR-4; AD-608239)

All design, fabrication, and testing of the static orbital fuel-cell package were completed. The 28-volt system requirements include the necessary work to develop, test, and deliver two laboratory prototype fuel-cell power systems, a fuel-cell analyzer, and two four-cell test modules with an associated test board. Design of the laboratory prototypes is complete. Component hardware has been received. Fabrication of the parts for the first 28-cell stack has been completed, and fabrication of the parts for the remaining stacks is nearing completion. Design of the fuel-cell analyzer is also complete. Author

N65-14086# Rocketdyne, Canoga Park, Calif.
HIGH-ENERGY BATTERY SYSTEM STUDY Third Quarterly Progress Report, 1 Jan.–31 Mar. 1964
J. Farrar, R. Keller, C. J. Mazac, and S. R. Webb [1964] 32 p refs
(Contract DA-36-039-AMC-03201(E))
(R-5405-3; AD-452714)

This report was concerned with systematic half-cell studies. Prospective electrode materials, electrolyte solvents, and salts were screened by testing in various combinations according to a statistical plan. These experimental results were then analyzed mathematically. Theoretical minimum weights for the anode and cathode can be estimated for a battery delivering 200Whr/lb based upon the measured potential. For lithium paired with CuF_2, this value is approximately 0.25 lb. The value for lithium paired with less favorable cathodes is 0.5 lb, which makes these combinations just feasible. Author

N65-14089# Texas Instruments, Inc., Dallas.
MOLTEN-CARBONATE FUEL BATTERY PROGRAM, TASK I Final Technical Report, 15 Feb. 1963–15 Feb. 1964
B. H. Barbee, J. F. Haefling, T. N. Hooper, R. C. Johnston, K. W. Kreiselmaier et al 31 Aug. 1964 165 p refs
(Contract DA-44-009-AMC-54(T))
(TI-08-64-114; AD-450397)

The major achievements were the following: (1) A self-sustaining fuel-cell system that operates on military fuels and air was shown to be feasible and was made and operated. (2) Fuel flexibility of this system was demonstrated by satisfactory operation on marine white gasoline, kerosene, jet fuel (JP-4), No. 2 diesel fuel, and CITE fuel. In all cases, air was the oxidant. (3) Performance is not affected by the presence of sulfur constituents in the military fuel. (4) A hydrogen generation system was developed for use with this fuel cell. It uses no catalyst and operates on air at just slightly above atmospheric pressure. (5) The materials used to make the system are neither unusual nor especially costly. The most expensive component is the silver used in the electrodes. Author

N65-14098# Republic Aviation Corp., Farmingdale, N.Y.
INVESTIGATION OF PULSATING FLOW HYDRAULIC CONCEPTS Second Quarterly Progress Report
F. H. Pollard 15 Nov. 1964 76 p
(Contract AF 33(615)-1582)
(RAC-1932-2; RD-TR-64-824; AD-608227)

Progress is reported on the design, fabrication, and testing of components peculiar to a pulsating-flow hydraulic system and on an analysis of pulsating-flow hydraulic systems to replace existing continuous flow hydraulic systems in flight vehicles. Work is reported on a rectifier valve, a piston-type transformer, a fluid volume compensator unit, a diaphragm-type transformer, a hydraulic alternator, and a system analysis. Each unit is described as to design, operating principles, and potential application. D.E.W.

N65-14100# Lockheed Missiles and Space Co., Palo Alto, Calif. Materials Sciences Lab.
LITHIUM-SILVER CHLORIDE SECONDARY BATTERY INVESTIGATION
J. E. Chilton, Jr. and R. W. Holsinger 14 Oct. 1964 29 p
(Contract AF 33(615)-1195)
(QTPR-3; AD-607968)

Aluminum cased cells are tested for leaks with a helium leak detector before filling. Hull cell experiments show best lithium deposition 10 to 4 mA per cm^2 for lithium chloroaluminate solutions. Silver chloride is 10^{10} times more insoluble in propylene carbonate than in water. Heat of reaction for lithium–silver chloride was found to be 67.5 ±1 kcal/mole. Lithium–silver chloride cell cycle life is improved at high temperature. The nickel chloride utilization (initial discharge) in a lithium–nickel chloride cell was found to be 20% for a voltage end point of 1.88 volts. Author

N65-14109*# ASTRA, Inc., Raleigh, N.C.
A SINGLE POINT COMPUTATION FOR A STEAM SPACE POWER PLANT
H. R. Kroeger and H. H. Hill 11 Jan. 1963 57 p refs
(Contract NASw-503)
(NASA-CR-60069; ASTRA-TM-205-1.10) OTS: HC $3.00/MF $0.50

The advantages of a steam system over systems for heat dissipation that use other fluids are enumerated. The fin configuration for a steam system is optimized, and formulas are derived for the optimum tube spacing in terms of condenser duty and condenser weight. The optimum temperature drop across the condenser is formulated and presented in graphs and tables. The optimum header arrangement is discussed, and condenser and header weights are tabulated for various tube lengths. It is noted that the radiator weight, which was calculated to be 680 lb (including headers and coolant) on the basis of higher meteoroid-puncture data, was revised downward, to less than 500 lb, on the basis of more accurate and lower calculated meteoroid-protection requirements. D.E.W.

N65-14231# National Cash Register Co., Dayton, Ohio. Research Div.
INVESTIGATION OF CHEMICALLY SPRAYED THIN-FILM PHOTOVOLTAIC CELLS Quarterly Report, 15 Aug. 1964–14 Nov. 1964
R. R. Chamberlin and J. S. Skarman [1964] 37 p
(Contract AF 33(615)-1578)
(QR-2; AD-609204)

Techniques for depositing thin films of cadmium sulfide, cadmium sulfide-selenide, Cu_xS_y, indium sulfide, and Ag_xS_y are described. A dilute water solution of an organic compound, such as cadmium thiocyanate, CdCNS, is sprayed in very fine droplets on clean glass or other substrate that is heated enough to decompose the organic compound. For CdCNS, the substrate temperature is 210° C. Crystallinity is affected by the spray temperature and rate, as well as by the substrate temperature. The spray equipment and the platen to hold and heat the substrate are described. The spectral response and cell resistance of various films are discussed, and broadening the spectral response is concluded to be necessary for improving the efficiency. Progress and methods of cell fabrication are reported, and the equipment and status of a test installation are described. D.E.W.

N65-14316# Aerospace Corp., El Segundo, Calif. Applied Mechanics Div.
ANALYTICAL INVESTIGATION OF NITROGEN JET REACTION CONTROL SYSTEMS
H. Greer 30 Nov. 1964 47 p refs
(Contract AF 04(695)-469)
(TDR-469(5560-30)-1; SSD-TDR-64-242; AD-453193)

The experimental results of a nitrogen jet reaction control system are analyzed, and correlations between theoretical and measured parameters are established. It is shown that accurate analytical predictions of impulse bit size, gas consumption, and effective specific impulse can be accomplished. Generalized performance relationships are presented over a range of thrust chamber geometry and pressure ratio as a function of command pulse width. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-13393# Bureau of Mines, Pittsburgh, Pa.
METHANE-OXIDIZING BACTERIA A Review of the Literature
Melvin P. Silverman 1964 42 p refs
(BM-IC-8246)

The literature reviewed concerns the growth and isolation of cultures by special techniques; the distribution of these organisms in nature and the descriptions of individual species; the physiology of methane-oxidizing bacteria as influenced by temperature, light, pH, aerobiosis versus anaerobiosis, and carbon and nitrogen sources; and the biochemistry of methane oxidation revealed by studies with intact cells and subcellular systems. Author

N65-13398# Joint Publications Research Service, Washington, D.C.
OUTLINES ON THE STRUCTURE AND FUNCTION OF THE BRAIN
S. A. Sarkisov 22 Dec. 1964 140 p refs Transl. into ENGLISH from the book "Ocherki po Strukture i Funktsii Mozga" Moscow, 1964 p 5-7, 9-17, 117-148, 173-209, 231-261
(JPRS-27947; TT-64-51986) OTS: $4.00

A discussion of the general problems on the structure and function of the human nervous system with consideration of research on the fine mechanisms of brain activity is presented. Special significance is given to the neuron and interneural connections in normal and pathological states. Electroencephalographic investigations to determine morphological structures and functions of individual regions of the brain are reported. E.C.

N65-13417# Joint Publications Research Service, Washington, D.C.
SOVIET ENVIRONMENTAL PHYSIOLOGY AND TOXICOLOGY (A SURVEY OF THE PUBLISHED LITERATURE, 1958-1964)
10 Dec. 1964 110 p refs
(JPRS-27767; TT-64-51901) OTS: $4.00

A survey of Soviet literature in physiology and toxicology is presented with differing opinions in regard to effectiveness of vaccination methods and specificity of certain tests for communicable diseases. Also, the following areas of space medicine are discussed: *Respiration, Artificial Atmospheres, Conditioning Techniques, Acceleration, Weightlessness,* and *An On-Board "Electronic Doctor".* The areas discussed in submarine medicine are: *Fatigue; Communicable Diseases; Cold, Heat and Nonspecific Resistance of the Organism;* and *Radioactivity and Air Contaminants.* A bibliography is included. E.C.

N65-13532# Ohio State U. Research Foundation, Columbus.
RESEARCH ON THE PRODUCTION OF CLINICAL RADIOGRAPHS BY MEANS OF COMPACT, LOW-ENERGY AND HIGH-INTENSITY RADIOACTIVE SOURCES Final Report, 15 Apr. 1958-30 Sep. 1964
H. D. Spangenberg and M. L. Pool Sep. 1964 20 p refs
(Contract Nonr-495(17))
(Rept.-5; AD-607174)

Of approximately 1300 currently known radioactive nuclides, only 48 appeared worthy of detailed study. Only 11 of these met the criteria essential for eventual clinical usefulness. The criteria chosen were that the radioactive nuclides be readily available, be capable of easy production, have a half-life of one month or more, possess a suitable emission spectrum, and be capable of providing a high specific activity source. Some of the important properties of the 48 radioactive nuclides, used in their evaluation in accordance with the five criteria, are tabulated. Although no one nuclide holds first position in each of the above five criteria nevertheless I^{125}, Cs^{131}, Ce^{144}, Sm^{145}, Gd^{153}, Eu^{155}, Dy^{159}, Yb^{169}, Tm^{170}, Hf^{175}, and W^{181} reasonably satisfy the requirements for isotopic radiography. Author

N65-13546*# General Technical Services, Inc., Cleveland, Ohio.
ANALYSIS OF THE DYNAMIC SYSTEMS RESPONSE OF SOME INTERNAL HUMAN SYSTEMS
A. S. Iberall and S. Z. Cardon Washington, NASA, Jan. 1965 115 p refs
(Contract NASw-1066)
(NASA-CR-141) OTS: HC $4.00/MF $1.00

This document summarizes the first round of theoretical and experimental work undertaken on specific internal biologic systems. It discusses the thermoregulation system, the cardiovascular system, the harmonal system, and the behavioral system. Author

N65-13626*# National Aeronautics and Space Administration, Washington, D.C.
AVIATION AND SPACE MEDICINE
V. V. Parin, ed. Dec. 1964 464 p refs Transl. into ENGLISH of the book "Aviatsionnaya i Kosmicheskaya Meditsina" Moscow, Akad. Med. Nauk SSSR, 1963
(NASA-TT-F-228) OTS: HC $7.63/MF $2.25

For titles of individual papers see N65-13627 through N65-13781, Issue No. 4, Categories 04 and 05.

N65-13627* National Aeronautics and Space Administration, Washington, D.C.
RESULTS OF PHYSIOLOGICAL INVESTIGATIONS ON THE SPACESHIPS VOSTOK 3 AND VOSTOK 4
I. T. Akulinichev, R. M. Bayevskiy, V. Ye. Belay, P. V. Vasil'yev, O. G. Gazenko et al *In its* Aviation and Space Med. Dec. 1964 p 3-5 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

According to EEG data, during the first few hours of exposure to weightlessness there was a predominance of rhythms with a frequency of 5 to 7 oscillations per second and a comparatively high amplitude. Later there was a gradual shift toward high frequency oscillations (β rhythm) with a decrease in average amplitude. The daily periodicity of electric resistance of the skin remained unimpaired throughout the flight. According to electro-oculogram data, asymmetry of oculomotor reactions, which might indicate impairment of the vestibular centers, and nystagmus were not detected in either astronaut. The changes in oculomotor activity in both astronauts were phasic in character. Eye movements were sweeping and frequently uncoordinated. No cardiac or respiratory abnormalities were observed. The mental activity and neuroregulatory capabilities of the astronauts remained on a high level. P.V.E.

N65-13628* National Aeronautics and Space Administration, Washington, D.C.

CHANGES IN SOME INDICES OF RESPIRATORY BIOMECHANICS IN SICK AND HEALTHY PERSONS UNDER THE CONDITIONS OF HYPOXIA

V. N. Alifanov *In its* Aviation and Space Med. Dec. 1964 p 5–9 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Presented are data on changes in maximum pulmonary ventilation (MPV) and respiratory reserve, volumetric flow rate of air during forced inhalation and exhalation (pneumotachometry), forced vital capacity of the lungs (FVCL), and forced vital capacity during the first second of exhalation (Tiffno's index). These data were obtained while the subjects were in a pressure chamber at a simulated altitude of 5000 m and again while they were breathing mixtures of gases containing 11% oxygen under normal atmospheric pressure. The subjects were 30- to 40-year old pilots, both healthy men and those with incipient signs of cardiovascular disease or residual symptoms of respiratory disease. The subjects exhibited a significant increase in the MPV averaging 20% to 28% in the simulated altitude studies, but no significant changes in the MPV were noted on breathing the hypoxic mixture. The FVCL did not change significantly during either investigation. Tiffno's index in rarefied air had a distinct tendency to be low in the healthy persons and in those with residual symptoms of lung pathology. The space velocity of forced inhalation did not change significantly in subjects breathing the hypoxic mixture, but increased in all subjects at the simulated 5000-m altitude. P.V.E.

N65-13629* National Aeronautics and Space Administration, Washington, D.C.

CHANGES IN BIOELECTRIC ACTIVITY OF THE MYOCARDIUM IN MAN AFTER EXPOSURE TO HYPOXIC HYPOXIA ACCORDING TO THE DATA OF VECTOR ANALYSIS

V. N. Alifanov and L. M. Zemesheva *In its* Aviation and Space Med. Dec. 1964 p 9–11 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Investigations were conducted in a pressure chamber where the subjects remained for 30 minutes at an "altitude" of 5000 m. EKG's, taken before the "climb" and after 20 min. at the altitude, were recorded in standard, amplified, and unipolar thoracic leads, which made frontal vector measurement possible, and in Aricci's leads, which permitted vector analysis of the EKG to be made in a sagittal plane. Pilots 35 to 45 years old with good tolerance of hypoxia (15 healthy persons and 15 persons with incipient atherosclerotic cardiosclerosis) were examined. Neither the direction nor the magnitude of the sagittal vectors changed reliably under the conditions of hypoxia. In the healthy persons, the most characteristic changes occurred in connection with frontal vector measurements. The frontal vector measurement in persons with cardiosclerosis had its own peculiarities, which were indicative of some oxygen deficit of the myocardium. P.V.E.

N65-13630* National Aeronautics and Space Administration, Washington, D.C.

BIOTELEMETRY ON MANNED SPACE FLIGHTS

G. V. Altukhov *In its* Aviation and Space Med. Dec. 1964 p 12–14 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A general discussion of the problems involved in medical monitoring of manned space flights is presented. Unlike laboratory equipment, the instruments on a spaceship must be very small and light, and operate efficiently and reliably when exposed to overloads and other flight factors. Some methods used in the flights of Gagarin, Nikolayev, and Popovich are outlined in general. The application of computers to the interpretation and mathematical processing of the telemetry data is also discussed. P.V.E.

N65-13631* National Aeronautics and Space Administration, Washington, D.C.

SOME PROBLEMS IN THE PSYCHOLOGY OF FLIGHT ACTIVITIES

B. S. Alyakrinskiy *In its* Aviation and Space Med. Dec. 1964 p 14–17 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The problems of training young pilots, particularly to read and interpret instruments, are discussed. The idea of informograms is presented. An objective informogram is a characterization of the optimum cross section of pilot activity during a given portion of flight. A subjective informogram would result from solving one actual problem encountered by a pilot. A comparison of objective and subjective informograms makes it possible to analyze in detail specific flight conditions, and to judge the relationships among the demands made on man by flight activities, particularly those requiring the functioning of his visual analyzer. In devising individual training programs, it would be possible to have a characteristically individual informogram, which, when compared with the subjective informogram, would enable an instructor to predict the difficulties involved in learning and relearning the science of aerial navigation. P.V.E.

N65-13632* National Aeronautics and Space Administration, Washington, D.C.

SOME PROBLEMS IN ENSURING THE RADIATION SAFETY OF SPACE FLIGHTS

V. V. Antipov, V. G. Vysotskiy, B. I. Davydov, N. N. Dobrov, V. S. Morozov et al *In its* Aviation and Space Med. Dec. 1964 p 18–20 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

It is essential to know the specific role played by cosmic radiation in the overall effect of the various flight factors on the human organism, and, conversely, to know the influence of the nonradiation flight factors on the qualitative and quantitative aspects of the biological effect of radiation. Experiments have indicated that acceleration and vibration will variously affect the development of radiation lesions depending on when and in what order these factors are applied. For long space flights, the question arises as to whether certain doses of cosmic radiation can induce hereditary changes in plants and animals that might severely disrupt the balance existing in a closed ecological system existing on a spacecraft. These and other problems must be solved to assure the radiation safety of space flights. P.V.E.

N65-13633* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF DIFFERENT PARTIAL PRESSURE OF OXYGEN AND ENVIRONMENTAL TEMPERATURE ON REGULATION OF TEMPERATURE RELATIONS IN THE ORGANISM

I. I. Antonov *In its* Aviation and Space Med. Dec. 1964 p 20–24 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The extent to which environmental temperature affects the balancing of heat exchange between the environment and organism exposed to different partial pressures of oxygen was investigated. Conclusions drawn from the data presented include: (1) A change in the partial pressure of O_2 in the atmosphere significantly influences the thermoregulatory function of the body. Progressive hypothermia arises and impairs the normal temperature relations among the various organs and tissues.

(2) The environmental temperature is an important factor in maintaining the thermoregulation at a suitable level in hypoxemia and hyperoxemia. (3) Adaptation in general and thermoregulation in particular of animals to different partial pressure of O_2 are effected by the cerebral cortex. (4) The mechanisms responsible for the development and course of temperature impairment in organisms experiencing either an oxygen insufficiency or the toxic effects of oxygen are similar. P.V.E.

N65-13634* National Aeronautics and Space Administration, Washington, D.C.

MEDICAL SERVICE FOR THE CIVIL AIR FLEET OF THE USSR

A. S. Asribekov *In its* Aviation and Space Med. Dec. 1964 p 24–26 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The development and activities of the medical branch of the Civil Air Fleet (CAF) are discussed. The medical branch is concerned with the medical care and physical well-being of aircraft crews and passengers. The major problems and subjects for future research are outlined. P.V.E.

N65-13635* National Aeronautics and Space Administration, Washington, D.C.

LABOR HYGIENE IN THE SPRAYING OF CHEMICALS FROM CIVILIAN AIRPLANES

T. A. Asribekova *In its* Aviation and Space Med. Dec. 1964 p 26–28 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Various investigations into industrial hygiene with respect to the use of insectofungicides sprayed from aircraft are outlined. The investigations began in 1925 when chemicals sprayed from aircraft were used to control locusts. Current investigations include the study of the effects of the chemicals on humans, the development of protective equipment, handling problems, and evaluation of prophylactic and therapeutic treatment for anyone affected by sprayed chemicals. P.V.E.

N65-13636* National Aeronautics and Space Administration, Washington, D.C.

PHARMACOLOGICAL PROPHYLAXIS AND THERAPY OF AIRSICKNESS

Z. A. Astakhova, Ye. P. Belogortseva, M. D. Kruglik, and P. I. Syabro *In its* Aviation and Space Med. Dec. 1964 p 28–32 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Studies were made on passengers for whom drugs had been prescribed to prevent and to treat airsickness. Combinations of preparations used were (1) Platybrin—a double tartrate of platyphylline (5 g) with caffeine, sodium benzoate, and sodium bromide (15 g each); (2) Platybrin No. 2—Platybrin with 0.1 g of pure caffeine instead of 15 g of caffeine and 15 g of sodium benzoate, and 0.15 g of potassium bromide instead of sodium bromide; (3) PPKB—Platybrin No. 2 with 0.3 g of papaverine hydrochloride; (4) FPPKB—PPKB plus 5 mg of amphetamine; and (5) Platkof—5 mg of platyphylline bitartrate and 150 mg of caffeine and sodium benzoate. The drugs arranged in order of effectiveness are Platybrin and Platybrin 2; PPKB; and FPPKB. These drugs are recommended for prevention and treatment of airsickness. P.V.E.

N65-13637* National Aeronautics and Space Administration, Washington, D.C.

THE DOG SPLEEN RESPONSE TO LATERAL ACCELERATION

Yu. I. Afanas'yev *In its* Aviation and Space Med. Dec. 1964 p 32–35 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Reactive changes in the spleen of dogs subjected to accelerations were investigated. Two experiments were performed on 28 dogs subjected to a single lateral, chest-back acceleration of 8 g for 3 min, and to 12 g for 1 min. The animals were immunized against plague 2 weeks before the experiment. Conclusions drawn from the experimental results include: (1) Accelerations (both 8 and 12 g) produce degenerative changes in the endothelium of the blood vessels, smooth-muscle cells of the trabeculae and capsule of the spleen, and rupture of vascular walls, causing thrombogenesis therein. (2) Lymph nodes are emptied the first day after acceleration and proliferation of lymphoblasts is inhibited. (3) The histological structure of the spleen returns to normal 2 months after exposure to accelerations. P.V.E.

N65-13638* National Aeronautics and Space Administration, Washington, D.C.

THE EFFICIENCY OF MAN EXPOSED TO RADIAL ACCELERATION AND BREATHING OF OXYGEN AT AN EXCESS PRESSURE

V. I. Babushkin and V. V. Usachev *In its* Aviation and Space Med. Dec. 1964 p 36–38 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The effect of radial acceleration on humans breathing oxygen under pressure was studied. The investigations were conducted both in a centrifuge and under flight conditions. It was found that an altitude-compensating suit (ACS) increases tolerances to accelerations by a factor of 0.5 to 1 g. With acceleration and normal pressure breathing of oxygen, the cardiac rate increased by 26 to 60 beats per minute over the initial values. With breathing of oxygen under pressure (350 mm H_2O), the increased cardiac rate was lowered by 16 to 42 beats. When breathing oxygen under pressure but without acceleration, exhalation lasted 2.2 to 4 sec, and inhalation 1.2 to 1.9 sec. During an acceleration of 4 g, exhalation varied in duration from 1.6 to 3.2 sec and inhalation 1 to 1.8 sec. Under conditions of accelerations and breathing at excess pressure (and with the use of an ACS) the subjects experienced considerable difficulty in doing routine work. P.V.E.

N65-13639* National Aeronautics and Space Administration, Washington, D.C.

PHYSIOLOGICAL REACTIONS TO RADIAL ACCELERATION

V. I. Babushkin, P. K. Isakov, V. B. Malkin, and V. V. Usachev *In its* Aviation and Space Med. Dec. 1964 p 38–41 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Presented is a partial summary of experiments performed to investigate the effects of radial acceleration on the physiological functions and fitness of fliers. The investigations involved centrifuge as well as actual curvilinear flight tests. Areas of investigation included: (1) reasons for individual resistance to accelerations; (2) the role of the conditioned-reflex component in the mechanism of development of compensatory reactions to excess accelerations; (3) studies of the bioelectrical activity of muscles of the chest, abdomen, and lower extremities in response to accelerations of different intensities; (4) the effects of wearing a g-suit; and (5) gas exchange in the body following exposure to accelerations. P.V.E.

N65-13641* National Aeronautics and Space Administration, Washington, D.C.

DYNAMICS OF THE ELIMINATION OF CORTICOSTEROIDS AFTER VARIOUS ACTIONS

I. S. Balakhovskiy and I. G. Dlusskaya *In its* Aviation and Space Med. Dec. 1964 p 44–45 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The dynamics of the endocrine reactions of rats to sound stimulation and physical exertion (swimming) was studied along with the functional state of the adrenal cortex in fliers and other subjects under conditions characteristic of modern flying. Increased adrenocortical activity was found in all cases. The hormonal reaction in rats to sound or physical exertion was pronounced (an increase of more than 150%); it continued throughout the action (15 to 30 min) and for about 1.5 hours after the activity was halted. Data obtained in pressure-chamber tests showed that human subjects were in a "prestart" state characterized by increased urinary excretion of adrenocortical hormones before the test. Examination of flying personnel completing short flights under different conditions showed that, during flights marked by unusual difficulties, more corticosteroids were excreted than during ordinary flights (increases of 300% to 400% and 40% to 80%, respectively). P.V.E.

N65-13642* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF ACCELERATIONS ON THE GROWTH OF LIVING BEINGS

V. I. Baranov, A. A. Gyurdzhian, M. A. Lomova, L. A. Radkevich, L. T. Tutochkina et al *In its* Aviation and Space Med. Dec. 1964 p 46–49 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A special rotating device was used to raise animals under conditions involving prolonged exposure to acceleration. The experiments were performed on white laboratory rats exposed from birth to 4 to 6 hours of rotation daily. The intensity of centripetal acceleration was 1.5 to 3 g. The experimental and control groups were made up of rats from two litters born at approximately the same time. While being rotated the animals were able to move and take food. No differences were noted between the two sets of animals in tolerance to lethal accelerations. The general condition of the experimental rats did not differ from that of the control. However, experimental rats lagged considerably in weight, achieving only 60% to 80% of the control between the 20th and 50th days, and excreted appreciably less. Experimental females exhibited marked impairment of the estrus cycle. P.V.E.

N65-13643* National Aeronautics and Space Administration, Washington, D.C.

LEADING TRENDS IN AVIATION AND SPACE OPHTHALMOLOGY

V. V. Baranovskiy *In its* Aviation and Space Med. Dec. 1964 p 49–51 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Directions in which experimentation and investigations in aviation and space medicine should proceed are outlined. Areas mentioned include: (1) determination of the maximum functional capabilities of the eye in connection with the physical and dynamic factors involved in flying; (2) study of the effects of prolonged exposure to rarefied atmospheres, of breathing at excess pressures, and of acceleration and weightlessness; (3) creation of comfortable seeing conditions in aircraft cabins; (4) determination of the basic laws of visual orientation; and (5) determination of the capacity of the visual analyzer, the maximum amount of information that can be processed in a unit of time, and the degree of change in the volume of information that can be processed while other analyzers are functioning. P.V.E.

N65-13644* National Aeronautics and Space Administration, Washington, D.C.

THRESHOLD CONTRASTS AND BRIGHTNESS TO ENSURE VISIBILITY OF OBJECTS AT NIGHT AND DURING THE DAY

V. V. Baranovskiy, L. N. Meyer, and V. V. Preobrazhenskiy *In its* Aviation and Space Med. Dec. 1964 p 51–53 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Laboratory and field investigations of threshold contrasts and brightness in relation to the time of presentation of objects under nighttime and daytime conditions are discussed. Seventy observers with a visual acuity of at least 1 took part in the investigations. Each observer, after a short training period, determined the visibility of objects as they appeared and disappeared in the visual field. The data show that the threshold brightness required to discriminate the silhouette of an object grows with increasing brightness of the background. The smaller the angular dimension of the object, the greater the brightness that is required to discriminate it. The threshold brightness for the appearance of an object is 1.5 to 2 times higher than the threshold brightness when it becomes invisible. It was found that virtually instantaneous discrimination of objects at night could be achieved by doubling the threshold brightness established in the case of an unlimited time of observation. P.V.E.

N65-13645* National Aeronautics and Space Administration, Washington, D.C.

A NEW METHOD OF STUDYING THE TENDENCY TO ILLUSIONS OF SPATIAL ORIENTATION

V. V. Baranovskiy and I. D. Semikopnyy *In its* Aviation and Space Med. Dec. 1964 p 53–56 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

In order to assess the effect of visual–kinesthetic stimuli on the excitability of the vestibular apparatus, i.e., on the functional asymmetry of the labyrinth, the degree to which subjects would turn when walking with eyes closed before and after observing moving objects was determined. Before visual–kinesthetic stimulation, 90% of the subjects turned their trunk about 360° while 1 subject (out of 108) turned more than 720°. After visual-kinesthetic stimulation, 72% made turns of about 360°, while 10% of the persons turned more than 720°. In most of the subjects (85 out of 108), the turn after observation of the moving objects was in the direction opposite to that of the movement. It is concluded that the method makes it possible to detect about 96% of persons who develop functional asymmetry of the labyrinth, which results in a misconception of the spatial orientation. P.V.E.

N65-13646* National Aeronautics and Space Administration, Washington, D.C.

INCREASING RESISTANCE AS A MEANS OF PROVIDING BIOLOGICAL PROTECTION AGAINST VARIOUS ENVIRONMENTAL FACTORS DURING FLIGHT

Z. I. Barashova *In its* Aviation and Space Med. Dec. 1964 p 56–59 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A general discussion is presented of the need for developing methods of increasing the resistance of the human body to the adverse factors that are encountered in high-altitude flights and in space travel. Some observations of the way in which the body reacts to particular factors are mentioned, and the possibility of developing an increased nonspecific resistance as a result of complex conditioning is discussed. P.V.E.

N65-13647* National Aeronautics and Space Administration, Washington, D.C.

RESPIRATION AND GAS EXCHANGE IN AN ACUTE HYPOXIC TEST

A. V. Beregovkin, P. V. Buyanov, and V. B. Malkin *In its* Aviation and Space Med. Dec. 1964 p 59–62 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

An attempt was made to determine the general principles underlying changes in respiration and to detect individual respiratory reactions to hypoxia. Acute hypoxic hypoxia was caused by inhalation of gaseous mixtures of nitrogen with oxygen (9.3% to 10.9% and 8% to 8.5%). Forty-eight essentially healthy males ranging in age from 20 to 23 years were investigated. The principal indices of respiration and gas exchange were determined at rest, during breathing of the gaseous mixture, and after changing to breathing of atmospheric air. From the results obtained it is concluded that the diagnostic criteria of low resistance to oxygen deficiency were the absence of an appreciable change in the volume of pulmonary ventilation or a sharp increase therein (over 100%), a decrease in the depth of respiration, a marked decrease in vital capacity (40% or more), and a marked reduction of gas exchange early in the test followed by a slow return to normal. P.V.E.

N65-13648* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF CHANGE IN THE GAS MEDIUM ON "PRIMARY POTENTIALS" OF THE AUDITORY AREA OF THE CEREBRAL CORTEX IN ANIMALS AND ON SOME FUNCTIONS OF THE ACOUSTIC ANALYZER IN MAN

E. V. Bondarev *In its* Aviation and Space Med. Dec. 1964 p 62–64 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The effect of flight factors on the acoustic analyzer was studied by determining (1) the influence of hypoxia and substitution of helium for nitrogen in the ambient atmosphere on the "primary potentials" of the auditory area of the cerebral cortex in response to sound, and (2) the influence of moderate hypoxia on some functions of the human acoustic analyzer. The results of the investigation indicate the following: (1) Changes in the "primary potentials" of the auditory area of the cat cortex begin to appear at an "altitude" of 5000 m and become more pronounced at 8000 to 9000 m. (2) With hypoxia, there is a lengthening of the latent period of the "primary potentials", a progressive decrease in the amplitude of the negative phase, and an increase in and shortening of the positive phase. (3) Moderate hypoxia at an "altitude" of 5000 m raises the threshold of perception of sound in healthy subjects but somewhat reduces the intelligibility of words at low sound intensities. P.V.E.

N65-13649* National Aeronautics and Space Administration, Washington, D.C.

THE POSSIBILITY OF BIOLOGICAL OBJECTS GROWING AND LIVING A LONG TIME IN A HELIUM-OXYGEN ATMOSPHERE

V. V. Boriskin, P. A. Gul'tyayev, and B. M. Savin *In its* Aviation and Space Med. Dec. 1964 p 64–67 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The possibilities of chick embryos and frog egg cells developing in a helium–oxygen atmosphere, and of chicks, white mice, and dogs living in the helium–oxygen atmosphere for 10 to 15 days were investigated. Parallel experiments were performed with the same biological objects in a nitrogen–oxygen atmosphere. The results indicated that substituting helium for nitrogen in the ambient atmosphere had no appreciable effect on embryonal development. When a higher ambient temperature was maintained in order to preserve the thermal balance, long exposure to the helium–oxygen atmosphere did not impair the vitality of animals representing different stages of phylogenetic development. P.V.E.

N65-13650* National Aeronautics and Space Administration, Washington, D.C.

SOME ASPECTS OF MEDICAL EXAMINATION OF FLIGHT PERSONNEL

K. F. Borodin *In its* Aviation and Space Med. Dec. 1964 p 67–70 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The main principles behind medical examinations of flight personnel are discussed and outlined. Also discussed are the trends in research aimed at finding new methods of investigation that are compatible with flying conditions. Two main trends are considered in particular. The first trend is toward the determination of the functional capabilities of the individual with respect to concrete flying conditions, and the second is concerned with detecting incipient forms of diseases and latent functional impairments. P.V.E.

N65-13651* National Aeronautics and Space Administration, Washington, D.C.

OBESITY IN FLIERS

T. M. Buznik *In its* Aviation and Space Med. Dec. 1964 p 70–73 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The general problem of obesity is discussed. It is pointed out that there are many factors which affect the development of obesity, such as food intake, metabolic impairment, and psychological factors. It is suggested that obesity should be eliminated as slowly and as imperceptibly as it usually develops. P.V.E.

N65-13652* National Aeronautics and Space Administration, Washington, D.C.

FUNCTIONAL EVALUATION OF BLOOD CIRCULATION FROM CHANGE IN CIRCULATION EFFECTIVENESS. VALUE OF THE METHOD IN SELECTING AND TRAINING FLYING PERSONNEL

P. V. Buyanov *In its* Aviation and Space Med. Dec. 1964 p 73–76 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Oxygen utilization and cardiac output both under conditions of complete physical rest and after various actions (measured physical exercise, breathing at a high pressure, oxygen deficiency, and hypodynamia) were investigated simultaneously. The concept of an index of blood circulation effectiveness was introduced. This index is determined from the volume of blood used per 100 m^3 of oxygen utilized by the body. From the data obtained the following conclusions are suggested: (1) The differences observed in blood circulation in relation to oxygen utilization are connected with the state of the mechanisms of blood circulation regulation. (2) The value of the index of circulation effectiveness lies in qualitatively characterizing the functional state of blood circulation in satisfying the energy requirements of the body. P.V.E.

N65-13653* National Aeronautics and Space Administration, Washington, D.C.

FUNCTIONAL CHANGES IN THE CARDIOVASCULAR SYSTEM AFTER EXPOSURE TO HYPODYNAMIA

Yu. V. Vanyushina *In its* Aviation and Space Med. Dec. 1964 p 76–78 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

An attempt was made to determine how the cardiovascular reflexes that resist gravity might change in human beings required to remain a long time in circumstances that limit reflex impulses from the muscles and cardiovascular system. Experiments involving subjects immobilized for 5.5 to 10.5 days in a special armchair in a position of maximum muscular relaxation and involving subjects who remained suspended in a tank of water for 5.5 to 11.5 days were performed. It was found that in human beings remaining for a long period of time under conditions of limited mobility, the adaptive reactions of the cardiovascular system to the force of gravity decrease. The weakening of the mechanisms was manifested during orthostatic testing, by a sharp acceleration of the pulse, a drop in systolic and pulse pressure, and slight cerebral anemia.
P.V.E.

N65-13654* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF SOME DRUGS ON TOLERANCE OF ACCELERATIONS

P. V. Vasil'yev and V. Ye. Belay *In its* Aviation and Space Med. Dec. 1964 p 79–84 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Data obtained in experiments with sympathomimetic amines and anesthetics are presented. The experiments were performed on mice, rats, rabbits, and dogs. The results obtained included the following: (1) Intramuscular injection of 0.17 mg/kg of norepinephrine 15 to 30 min. before rotation led to a delay in the onset of bradycardia. (2) Intravenous injection of 0.025 mg/kg to 0.1 mg/kg of norepinephrine 2 to 3 min. before rotation produced contradictory data as did administration of 0.1 to 1 mg/kg of epinephrine. (3) Intraperitoneal injection of 0.8 to 1 mg/kg of amphetamine 15 to 30 min. before acceleration increased the resistance of mice as did 1.0 mg/kg of ephedrine. (4) Injection of 200 mg/kg of chloral hydrate 15 min. before the start of rotation increased resistance by 2 to 10 units, whereas a 400 mg/kg dose reduced it from 65 to 48 units. (5) A dose of 30 mg/kg of pentothal sodium increased tolerance of accelerations by 4 to 19 units, but a 100 mg/kg dose reduced it by 14 units. P.V.E.

N65-13655* National Aeronautics and Space Administration, Washington, D.C.

STRUCTURAL AND CYTOCHEMICAL INVESTIGATIONS OF THE UTRICLE UNDER THE CONDITIONS OF RELATIVE REST AND AFTER EXPOSURE TO ACCELERATIONS

Ya. A. Vinnikov, O. G. Gazenko, L. K. Titova, A. A. Bronshteyn, and V. I. Govardovskiy *In its* Aviation and Space Med. Dec. 1964 p 85–87 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Electron microscopic studies of the utricle of mammals (guinea pigs and rhesus monkeys) and birds (pigeons) at relative rest revealed the presence of evolutionary gradations reflecting the ecological conditions of locomotion of these animals in a gravitational field. The utricle of the animals contained colunar hair cells supplied with button-like synapses, as well as jug-shaped sensory cells enclosed in cup-shaped synapses. In the cup, the guinea pigs have only one, the monkeys two, and the birds about five hair cells. Changes in structural and cytochemical organization of hair cells in the synapses of the utricle after acceleration are apparently characteristic of a state of excitation and transmission of impulses. The state is accompanied by a chain of biochemical processes that take place in a strictly determined substructural location. The processes are related to nucleic acid function, to oxidation enzyme activity, and to acetylcholinesterase activity.
P.V.E.

N65-13656* National Aeronautics and Space Administration, Washington, D.C.

OXYGEN SUPPLY OF THE HEART DURING RESPIRATION AT EXCESS PRESSURE

V. G. Voloshin *In its* Aviation and Space Med. Dec. 1964 p 87–90 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A series of chronic and pressure-chamber experiments on the coronary blood flow of dogs breathing at excess pressure are discussed. After exposure to noncompensated excess pressure, there was generally a decrease in the coronary blood flow followed by a slight increase. The removal of excess pressure resulted in an increase in the blood flow above the original level followed by a return to normal. Altitude experiments carried out in a pressure chamber frequently caused an increase in the coronary blood flow. The application of excess pressure caused a more or less appreciable increase in the blood flow; as the pressure and "altitude" increased, the blood flow decreased, with an eventual increase at high "altitudes". The results also confirmed the fact that excess pressure causes myocardial hypoxia, the degree varying with the amount of pressure.
P.V.E.

N65-13657* National Aeronautics and Space Administration, Washington, D.C.

ENSURING RADIATION SAFETY ON THE FLIGHTS OF ASTRONAUTS YU. A. GAGARIN, G. S. TITOV, A. G. NIKOLAYEV, AND P. R. POPOVICH

Yu. M. Volynkin, V. V. Antipov, N. N. Dobrov, M. D. Nikitin, and P. P. Saksonov *In its* Aviation and Space Med. Dec. 1964 p 90–93 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Radiation dangers that might be encountered in orbital space flights are discussed. Various data on the radiation in space are considered, and the radiation protective measures for the Vostok flights are outlined. Radiation safety was improved by structural features that prevented cosmic radiation, as well as manmade radiation, from penetrating the cabin of the spacecraft and by providing antiradiation drugs to be taken in case the radiation situation deteriorated greatly. Also discussed are the results of radiation dose measurements taken onboard the flights: The doses for Vostok flights one through four were 0.6 ±1.5, 12, 43 ±1, and 32 ±1 mrad, respectively.
P.V.E.

N65-13658* National Aeronautics and Space Administration, Washington, D.C.

CHANGES IN CARDIAC ACTIVITY DURING PROLONGED LATERAL ACCELERATIONS

A. D. Voskresenskiy *In its* Aviation and Space Med. Dec. 1964 p 94–97 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The hemodynamic changes caused by lateral acceleration of dogs were studied. The animals were exposed to acceleration bursts of 3, 6 and 9 g, of 1, 4, and 1 minute duration, respectively. Both back–chest (90° angle to the inertial force) and equal back–chest and pelvis–head (45° angle) components of acceleration were tested. The oxygen content of both the arterial blood flow and the coronary sinus blood flow was observed and standard EKG's were made. A relationship between the O_2 content of the arterial blood and the intensity and duration of the acceleration was established. The decrease

in O_2 content of the arterial blood and the intensity and duration of the acceleration was established. The decrease in O_2 content of the coronary sinus blood was accompanied by an increased sinus blood outflow to meet the heart's oxygen requirements. At the 45° angle, the outflow of the sinus decreased sharply, arhythmia and ventricular extrasystoles appeared, and irregular EKG patterns were observed. G.G.

N65-13659* National Aeronautics and Space Administration, Washington, D.C.
INTERRELATION OF HEMODYNAMIC CHANGES AND RESPIRATION DURING ACCELERATIONS
P. F. Vokhmyanin *In its* Aviation and Space Med. Dec. 1964 p 97–99 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Head–pelvis acceleration of dogs has shown that the vascular tone and venous pressure increase due to elevation of the intrapulmonary pressure. The motor protective reflexes are closely connected with respiration, activity of the diaphragm, and muscles of the chest and larynx during acceleration, and lead to expansion of the lungs and cyclical resistance to exhalation. A prolonged slowing of the blood circulation may result in hypoxia. G.G.

N65-13660* National Aeronautics and Space Administration, Washington, D.C.
INVOLVEMENT OF THE VESTIBULAR APPARATUS IN REGULATING THE BLOOD SUGAR LEVEL
R. Kh. Gambarova *In its* Aviation and Space Med. Dec. 1964 p 100–102 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A group of rabbits without functioning vestibular appartuses, as well as normal and drugged animals, were exposed to various rates and duration of rotation. The changes in blood sugar levels were determined before and after acceleration. The bilateral destruction of the vestibular apparatus increased the blood sugar content, which was little affected by subsequent rotation of the animal. A dependence of the blood sugar level on the number and rate of rotations was observed in the unaltered rabbits. The administration of caffeine and bromide changed the interoceptive metabolic reflexes from the vestibular apparatus. G.G.

N65-13661* National Aeronautics and Space Administration, Washington, D.C.
CHANGES IN THE BIOELECTRIC ACTIVITY OF DIFFERENT PARTS OF THE BRAIN DURING EXPOSURE TO PROLONGED ACCELERATIONS
O. G. Gazenko, B. B. Yegorov, G. V. Izosimov, Yu. P. Limanskiy, A. N. Rasumeyev et al *In its* Aviation and Space Med. Dec. 1964 p 102–105 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The bioelectric activity of the frontal, parietal, and accipital regions of the cerebral cortex was observed by mono- and bipolar EEG leads on a group of 18 men during head–pelvis as well as back–chest acceleration. The development of phase processes in the cortex was accompanied by a gradual fall in arterial pressure. The original bioelectric activity was gradually restored in the aftereffect period and became normal after 5 to 7 minutes. Further acceleration studies with 50 rabbits and microelectrode investigations of the brainstem reticular formation of cats showed that the inhibition of the reticular formation acts to protect the cerebral cortex from the injurious effects of acceleration. In general, prolonged accelerations cause significant changes in the bioelectrical activity of different parts of the brain that are evident from the onset of acceleration. G.G.

N65-13662* National Aeronautics and Space Administration, Washington, D.C.
ANTICIPATING REACTIONS IN FLIGHT ACTIVITY
S. G. Gellershteyn *In its* Aviation and Space Med. Dec. 1964 p 105–107 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Stimulus-and-reaction in the behaviorist interpretation does not accurately reflect the true nature of the sensorimotor activity of fliers in critical situations. This is proven by psychological analysis of the processes that characteristically take place: there is a genuine process of anticipation based on knowledge, past experience, or recognition of the logic of the development of events. If the expected events occur, the flier, thanks to anticipation, is better prepared to cope with them, and his actions are not only sounder but quicker. It is concluded that steps should be taken to study the anticipating processes for possible use in selection and training of flight personnel and in control of accidents. D.S.G.

N65-13663* National Aeronautics and Space Administration, Washington, D.C.
DATA ON THE BEHAVIOR AND SOME FUNCTIONS OF PERSONS KEPT UNDER THE CONDITIONS OF LIMITED MOBILITY
M. A. Gerd *In its* Aviation and Space Med. Dec. 1964 p 107–111 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

In this study of limited mobility effects, a total of 12 experiments lasting 2, 5, 7, and 10 days were conducted in which the subjects (healthy persons of 20 to 22 years of age) were placed in an armchair in a semi-reclining position—a position of maximum muscular relaxation. The techniques used to study motor activity and behavior included recording of movements, time study, and recording of actograms. Also, processes of excitation and inhibition in the CNS were studied, and daily inquiries and observations were made. The results showed that motor behavior, mental state, and several physical functions changed considerably in 10 out of 12 subjects. Analysis revealed that the changes, despite the variety of forms, fell into general patterns with characteristic features and five separate periods. It was concluded that, although the degree of immobilization used is close to the limits of tolerance, it can continue for more than 10 days without prolonged aftereffects, and complete restoration of all functions occurs in 2 to 4 days. D.S.G.

N65-13665* National Aeronautics and Space Administration, Washington, D.C.
THE EFFECT OF LOW CONCENTRATIONS OF CARBON MONOXIDE ON MAN IN PRESSURIZED CABINS OF PASSENGER PLANES
V. A. Gilinskiy, A. V. Chapek, A. G. Kozlova, N. M. Kulikova, and A. Ya. Loshak *In its* Aviation and Space Med. Dec. 1964 p 113–115 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The effects of low concentrations of carbon monoxide were studied on about 170 persons in pressure chamber experiments and actual airplane flights. A 3-hour exposure to carbon monoxide—starting with 0.01 mg/l or more—had adverse effects on the higher nervous activity, functions of the visual and vestibular analyzers, metabolic processes, cardiovascular system, muscular strength, tissue respiration, and leukopoiesis. A maximum permissible concentration of 0.01 mg/l carbon monoxide in pressurized passenger airplane cabins is suggested. G.G.

N65-13666* National Aeronautics and Space Administration, Washington, D.C.

MORPHOLOGICAL CHANGES IN THE NERVOUS SYSTEM OF ANIMALS SUBJECTED TO LATERAL ACCELERATIONS

B. S. Glushkov *In its* Aviation and Space Med. Dec. 1964 p 115–116 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Various divisions of the nervous system of seven rabbits were histologically investigated after the animals were exposed to single, lateral accelerations from 4.9 to 5.9 g for 60 to 180 seconds. Varying degrees of hemorrhaging were observed in the gray substance of all spinal cords and in the brains of four rabbits. Reversible cell changes were noted in the second and third layers of the cerebral cortex and the hippocampus. It is concluded that the morphological acceleration changes are caused by the disorder of the blood circulation in the CNS.

G.G.

N65-13667* National Aeronautics and Space Administration, Washington, D.C.

SOME FUNCTIONAL CHANGES IN MAN AFTER PROLONGED ISOLATION

F. D. Gorbov, V. I. Myasnikov, and V. I. Razdovskiy *In its* Aviation and Space Med. Dec. 1964 p 116–119 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Stress and fatigue parameters were observed on 18 subjects, confined for 10 to 15 consecutive days in a small chamber under practically complete isolation from outside stimuli. Simultaneous recordings of psychological and physiological indices were used to ascertain the qualitative aspects of the changes that took place, and to determine the state of tension and fatigue. The monotony of the surroundings, the limitations of external expressions, and the solitude were elementary in the development of stress and fatigue and should be prevented by effective stimulation.

G.G.

N65-13668* National Aeronautics and Space Administration, Washington, D.C.

THE MAIN PROBLEMS IN INVESTIGATING SHOCK OVERLOADS ARISING IN FLIGHTS ON AIRPLANES

S. A. Gozulov and G. P. Mirolyubov *In its* Aviation and Space Med. Dec. 1964 p 119–121 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Various groups of animals were exposed to shock overloads at high landing speeds, caused by catapulting followed by a parachute landing. Their physiological reactions were characterized by impairment of the rate and depth of respiration up to complete standstill, disruption of the rate and depth of respiration up to complete standstill, disruption of the cardiac system, change in arterial pressure, etc. The gross morphological and histological picture shows lung injuries to be the most frequent followed by liver, spleen, and intestine damage, in this order. Immersion in a liquid was found to reduce the landing impact, and the use of a gypsum bed permitted a safe landing on hard ground at a speed of 14 m/sec, which results in an impact of 1000 units. It was concluded that techniques should be developed and used for an early diagnosis of overload disorders in man to indicate the limit of physiological endurance and to investigate the biodynamic reactions of the body to shock overload.

G.G.

N65-13669* National Aeronautics and Space Administration, Washington, D.C.

INCREASING RESISTANCE TO OXYGEN DEFICIENCY BY MEANS OF DRUGS

G. I. Gurvich and K. S. Shadurskiy *In its* Aviation and Space Med. Dec. 1964 p 121–123 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Derivatives of indole and hydrazine were studied for their effects on oxygen deficiency resistance. Groups of guinea pigs, rats, and mice received 0.2 mg/kg serotonin intramuscularly 1 hour before exposure to hypoxia at 11 000 m elevation. The resistance to acute oxygen starvation was much higher in the experimental animals than in the controls. Experiments with 100 mg/kg iproniazid administered intraperitoneally in 150 white mice also produced considerable resistance to hypoxia, especially when the drug was injected 2 to 7 days before the exposure to oxygen deficiency. Oral administration of 5 mg/g BAS daily for 5 days in rats and mice increased the life span of the experimental animals at an "altitude" of 11 000 m far above that of the control group, and was even effective 10 days postdrug. Administration of indole I, indole IV, and indole XXIX to 140 mice increased their resistance to hypoxia also. It was concluded that the derivatives of indole and hydrazine can be very effectively used to increase resistance to oxygen deficiency.

G.G.

N65-13670* National Aeronautics and Space Administration, Washington, D.C.

WHITE RAT RESPIRATION AFTER PROLONGED EXPOSURE TO RADIAL ACCELERATIONS

V. I. Danileyko, A. I. Nazarenko, and O. S. Savchenko *In its* Aviation and Space Med. Dec. 1964 p 123–126 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The relationship between the biological effect of gravitational action and the body mass of small animals was confirmed on white rats. The oxygen utilization and respiratory rate of the animals were observed during centrifugal acceleration up to 50 units of varying duration. Respiratory movements were markedly impaired with increased acceleration. The oxygen utilization increased even with accelerations of 17 units lasting 5 minutes. A statistically significant increase in oxygen consumption by brain tissue was found after accelerations of 50 units lasting 1-1/2 minutes. The temperatures in the rectum and viscera of the white rats dropped simultaneously after prolonged intense gravitation by 10 or more degrees. It was concluded that the respiratory functions in a body, exposed to intense gravitation, change in all the components of respiration.

G.G.

N65-13671* National Aeronautics and Space Administration, Washington, D.C.

IMPAIRMENT OF THE MECHANISM OF MITOSIS IN MICROSPORES AFTER FLIGHT ON VOSTOK 3 AND VOSTOK 4

N. L. Delone, P. R. Popovich, V. V. Antipov, and V. G. Vysotskiy *In its* Aviation and Space Med. Dec. 1964 p 126–130 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Cut *Tradescantia* stems with inflorescences were taken on Vostok space flights and then analyzed by the acetocarmine method for metaphase, anaphase, and telophase mitotic changes, as well as binucleate pollen. The figures of the normal course of mitosis in *Tradescantia paludosa* microspores were changed, reflecting both impairment in the regular movement of the nucleus and impairment in the mechanism of mitosis itself. In other experiments, a 400-r dose of X-rays had no effect at all on the microspores, nor did accelerations of 5000 g impair mitosis. This led to the assumptions that only a fairly high dosage of ionizing radiation will disturb mitosis, and that the presence of weightlessness prevented acceleration damage.

G.G.

N65-13672* National Aeronautics and Space Administration, Washington, D.C.
QUALITATIVE (STAGE) EVALUATION OF FLIGHT FATIGUE
Ye. A. Derevyanko *In its* Aviation and Space Med. Dec. 1964 p 130–133 ref (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Indices of the CNS were studied by a number of methods of varying sensitivity to developing fatigue. Data from the following parameters were used to develop a stage system of evaluating the depth of fatigue: subjective condition of the flier, observations of the fliers' behavior, nature of the flights, dynamics of nervous and mental tension, and results of methodical investigations. G.G.

N65-13673* National Aeronautics and Space Administration, Washington, D.C.
PSYCHOPHYSIOLOGICAL CHARACTERISTICS OF INSTRUMENT FLYING
Ye. A. Derevyenko and N. D. Zavalova *In its* Aviation and Space Med. Dec. 1964 p 134–136 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Visual information in instrument flying requires the pilot to process the information about the spatial position of the plane, and to synthesize the individual signals into a complex image. An analysis of a pilot's action in controlling an airplane shows that the sensorimotor coordination of movements to control the craft constitutes his most complicated work during flight. This coordination of movements with instrument readings can be eased by the installation of instruments that yield coded information and decide for the pilot the amount, intensity, and smoothness of movements required for control purposes. G.G.

N65-13676* National Aeronautics and Space Administration, Washington, D.C.
EXCRETION OF 17-OXYCORTICOSTEROIDS IN AN INVESTIGATION OF THE EFFICIENCY OF AIRPLANE CREWS ON LONG NIGHT FLIGHTS
I. G. Dlusskaya, F. L. Kosmolinskiy, and N. A. Fedorov *In its* Aviation and Space Med. Dec. 1964 p 140–143 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The nervous system controls the maintenance of homeostasis through hormone secretions of the pituitary–adrenal system, which responds with increased output during stress situations. The total amount of bound and free 17-oxycorticosteroids in urine collected during long night flights was determined for several crews. It was found that the hormonal reactions in the captains and controllers or in the controllers and second pilots on the same flight were similar and assumed the form of parallel curves on graphs. This led to the conclusion that the amount of steroid hormones in urine increases in connection with the complexity of the performed task. G.G.

N65-13677* National Aeronautics and Space Administration, Washington, D.C.
VESTIBULAR INFLUENCES ON THE SMOOTH MUSCLES OF THE SMALL INTESTINE AND BLOOD VESSELS AFTER TRANSECTION OF THE SPINAL CORD AND VAGUS, CERVICAL SYMPATHETIC, AND SPLANCHNIC NERVES
A. S. Dmitriyev and Ye. V. Burko *In its* Aviation and Space Med. Dec. 1964 p 143–146 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The motility of the ileum, the tone of the intestinal wall, the blood pressure, and the respiration of 44 anesthetized dogs undergoing rotation were observed continually by mechanograms. Vestibular tests were made after transection of various trunk nerves and the spinal cord, and after bilateral labyrinth destruction. The ideal motility of all dogs was inhibited during the rotation, with return to normal in most cases after subsequent labyrinth destruction. The second series of experiments showed that the inhibition of the intestinal motility by acceleration persisted after bilateral transections of the vagus and cervical sympathetic nerves, but the changes in motility disappeared after exclusion of the labyrinths. It was concluded that the vestibular reactions can be executed by nervous as well as humoral mechanisms. G.G.

N65-13678* National Aeronautics and Space Administration, Washington, D.C.
SOME DATA ON AN INVESTIGATION OF CHAIN CONDITIONED MOTOR REFLEXES IN ANIMALS AFTER LONG EXPOSURE TO AN ALTERED GAS MEDIUM
G. P. Doronin *In its* Aviation and Space Med. Dec. 1964 p 147–149 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The method of chain conditioned motor reflexes was applied to white rats to investigate the complex stimuli that act in a definite sequence on a living organism under conditions of normal and high CO_2 content in the inhaled air at altitudes of up to 10000 m. A pCO_2 of about 14-mm Hg induced fluctuations in the time of execution of the individual links in the chain during the first 2 to 3 days, but did not affect the structure of the chain reflex. A higher pCO_2 (35.6 mm Hg) produced pronounced impairment of the established system of conditioned reflexes. The chain motor reflexes were restored during the second week of exposure to these conditions, but at a somewhat different level. Exposure to brief hypoxia at an altitude of 4000 to 5000 m impaired the structure of the chain motor reflexes, and phase states appeared. It was concluded that the method of chain motor reflexes is a highly sensitive and useful for testing. G.G.

N65-13679* National Aeronautics and Space Administration, Washington, D.C.
CHANGES IN THE CAPACITY OF THE CENTRAL NERVOUS SYSTEM WHILE LEARNING TO PILOT A TRAINING PLANE
V. A. Yegorov *In its* Aviation and Space Med. Dec. 1964 p 150–152 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The change in capacity to receive and process information was studied on 48 untrained persons using a TL-1 flight trainer. A total of 538 experiments required each subject to react to various radio commands by moving the proper levers on the trainer. A definite relationship was observed between the time required for processing the information and the complexity of the necessary movements. The time required to process 1 bit of information with simple movements was 0.096 to 0.117 sec, and, with complex movements, 0.180 to 0.189 sec. This difference gradually leveled out during training, paralleling the development of skills. A mean correlation of 0.94 was found between the capacity displayed in the above-described tests and the quality of execution of flight. G.G.

N65-13680* National Aeronautics and Space Administration, Washington, D.C.
CHANGE IN BACK PRESSURE ON THE BODY AND TOLERANCE OF RESPIRATION AT EXCESS PRESSURE

A. V. Yeremin and V. N. Alifanov *In its* Aviation and Space Med. Dec. 1964 p 152–154 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The correct fitting of the altitude-compensating suit (ACS), for providing uniform pressure on all parts of the body equal to intrapulmonary pressure, was studied on a number of subjects breathing under varying pressures. A variety of functional changes was observed during breathing of oxygen at excess pressure of 55, 104, 126, or 136 mm Hg on the ground and at an altitude of 20 km in a pressure chamber; duration of each exposure was no more than 5 minutes. Changes in the external back pressure on the entire body, and also on individual parts of the body were used to simulate defects of the ACS. It was found that a discrepancy of more than 50 mm Hg between pressure of the ACS suit on the body and intrapulmonary pressure resulted in marked and labored breathing and cardiovascular changes, thus impairing respiration tolerance at excess pressure. A good compensation of the abdomen and upper part of the thighs was of the greatest importance. At an altitude of 20 km, even a slight decrease in back pressure on the body was tolerated for more than 5 minutes. G.G.

N65-13681* National Aeronautics and Space Administration, Washington, D.C.

EFFECT ON MAN OF PROLONGED EXPOSURE TO ATMOSPHERE WITH A HIGH CO_2 CONTENT

S. G. Zharov, Ye. A. Il'in, Ye. A., Kovalenko, I. R. Kalinichenko, L. I. Karpova et al *In its* Aviation and Space Med. Dec. 1964 p 155–158 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The prolonged exposure of two men to an atmosphere of high CO_2 concentration was studied in two experiments. The subjects were exposed for 30 days to air containing either 1% or 2% CO_2. No significant effects on the sense of well-being, efficiency, or basic physiological functions were observed in the first experiment. The prolonged exposure to 2% CO_2 in air resulted in a large accumulation of both free and chemically bound CO_2 in the blood. Signs of acidosis, hypodynamics, and fatigue developed and intensified with the duration of the exposure. All changes were wholly reversible. G.G.

N65-13682* National Aeronautics and Space Administration, Washington, D.C.

EVALUATING THE BIOLOGICAL EFFECTIVENESS OF SPACE FLIGHT FACTORS BY MEANS OF THE LYSOGENIC BACTERIA E. COLI K-12 (λ)

N. N. Zhukov-Verezhnikov, I. N. Mayskiy, V. I. Yazdovskiy, A. P. Pekhov, N. I. Rybakov et al *In its* Aviation and Space Med. Dec. 1964 p 158–160 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Suspensions of a 5-hour culture of the lysogenic bacteria *E. coli* K-12(λ) were taken on Vostok space flights to observe their phage production induced by ionizing radiation. A specific antiphage serum was employed to inactivate the spontaneously originating phage particles. Laboratory experiments were also performed using combined and separate exposures of the suspension to gamma rays and vibrations. It was found that the number of phage particles in the experimental batches exposed to space flight exceeded that in the controls. This inducing effect persisted for 48 to 72 hours after landing. The effects of vibrations ranging from 35 to 700 cps suggest that vibration is a major factor in the radiogenetic effect in the lysogenic bacteria. The combined action of vibration and gamma irradiation followed by vibration intensified the biological effect of the gamma rays almost twofold. G.G.

N65-13683* National Aeronautics and Space Administration, Washington, D.C.

MODERN GENETICS AND PROBLEMS IN SPACE BIOLOGY

N. N. Zhukov-Verezhnikov, M. N. Volkov, V. I. Yazdovskiy, I. N. Mayskiy, P. P. Saksonov et al *In its* Aviation and Space Med. Dec. 1964 p 161–164 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

An overall view of future research to develop genetic safeguards for space travel is presented, on the basis of new information derived from a genetic analysis of the offspring of *Drosophila* and lysogenic bacteria that were carried on various Vostok space flights. The experiments with lysogenic bacteria imply that a combination of vibrations and γ-rays followed by vibrations almost doubled the genetic effects of the γ-rays. However, since effective levels of cosmic radiation were lacking in the orbits, it is assumed that weightlessness may be a possible source of genetic effects. The selection of lysogenic bacteria is advocated for future research to develop substances, to prevent genetic changes, to determine the effects of weightlessness, and to study blocking of the pathological information present in the DNA of these bacteria. G.G.

N65-13684* National Aeronautics and Space Administration, Washington, D.C.

IMPAIRMENT OF PROTECTIVE MECHANISMS FOLLOWING EXPOSURE TO AN ALTERED GAS MEDIUM

V. N. Zagryadskiy and Z. K. Sulimo-Samuyllo *In its* Aviation and Space Med. Dec. 1964 p 164–167 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The capacity of the organism to withstand high concentrations of carbon dioxide, which cause hypercapnia, as well as the factors that trigger the elimination of the carbon dioxide from the body were studied on humans and animals. The protective increase in human pulmonary ventilation was not effective at a CO_2 concentration above 3%. A prolonged exposure to low concentrations of CO_2 resulted in a high excitation of the cardiovascular center, and caused a diminished resistance to lateral accelerations and to breathing of oxygen at excess pressure. Prolonged hypocapnia in animals actuated the mechanisms that intensify the production of CO_2 in tissues, and resulted in vascular reflex changes. The impairment of CNS function in hyper- and hypocapnia results in inhibition or impairment of the compensatory reactions that maintain homeostasis. G.G.

N65-13685* National Aeronautics and Space Administration, Washington, D.C.

AN INVESTIGATION OF HIGHER NERVOUS ACTIVITY AND SOME MOTOR REACTIONS IN MAN UNDER CONDITIONS OF BRIEF WEIGHTLESSNESS

A. T. Zverev and L. A. Kitayev-Smyk *In its* Aviation and Space Med. Dec. 1964 p 167–168 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The impairment of speed and accuracy of motor reactions was studied in 139 experiments with human subjects during short parabolic flights. The subjects had to move various levers during exposure to angular acceleration and Coriolis accelerations created by rotation on a special armchair. Objective recordings of the test data showed that it was more difficult to work accurately during weightlessness than in the periods of acceleration. It is believed that the lowering of the speed and accuracy of the motor reactions during weightlessness was due to inhibitions in the corresponding points on the cerebral cortex as a result of a change in the level of proprioceptive afferent impulses. G.G.

N65-13686* National Aeronautics and Space Administration, Washington, D.C.
SOME ASPECTS OF HEMODYNAMICS IN BREATHING OXYGEN WITH HIGH PRESSURE IN THE LUNGS
D. I. Ivanov *In its* Aviation and Space Med. Dec. 1964 p 169–172 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The rate of blood flow in the pulmonary circulation of dogs under acute and chronic pressure in the lungs was determined by radioactive tracer methods. The magnitude of the resistance to the blood flow and the incomplete systolic emptying of the right ventricle became more pronounced with the intensity of the created pressure in the lungs, and severely impaired the hemodynamics of the pulmonary circulation. The same observations were made in experiments with the local tissue blood flow in man, as well as in studies of the venous blood flow of animals while breathing oxygen with high pressure in the lungs. It was concluded that an increase in lung pressure regularly altered the linear and volumetric rate of the blood flow, resulting in hypoxia and marked changes in the venous blood circulation. G.G.

N65-13687* National Aeronautics and Space Administration, Washington, D.C.
CHANGES IN MAN'S PRINCIPAL PHYSIOLOGICAL FUNCTIONS AFTER PROLONGED EXPOSURE TO LOW BAROMETRIC PRESSURE IN A SMALL SPACE
D. I. Ivanov, V. B. Malkin, I. N. Chernyakov, V. L. Popkov, and Ye. O. Popova *In its* Aviation and Space Med. Dec. 1964 p 172–175 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The dynamics of man's physiological functions and their changes through disruption of the normal diurnal rhythm were studied on several pairs of test subjects who remained for 30 days in a small pressure chamber in a rarefied atmosphere corresponding to altitudes of 3000, 5000, and 7000 m. No clear-cut relationship between the barometric pressure and changes in the physiological indices was established. The nature and direction of physiological changes were largely determined by sleep and relaxation routines. The criterion for selections of optimal regimens should be the time of day set aside for sleep, not merely the number of hours. G.G.

N65-13688* National Aeronautics and Space Administration, Washington, D.C.
HYPOXIA AND CHEMICAL THERMOREGULATION
K. P. Ivanov *In its* Aviation and Space Med. Dec. 1964 p 175–177 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The muscular gas exchange, cold tremor, and the thermoregulation muscle tonus were investigated in order to locate the sources of controllable heat production in warm-blooded animals. The decrease of oxygen utilization in rats and rabbits during hypoxia at an ambient temperature of 10° to 25° C coincided with a depression of the muscle electrical activity. The oxygen utilization of the rabbit femoral muscles increased 30% to 150% through the stimulation of the thermoregulation tonus, and 200% to 400% through stimulation of the cold tremor reflex. A positive correlation between suppression of the electrical activity of muscles and the gas exchange was established. It was concluded that hypoxia influences and inhibits the central thermoregulatory mechanism through a decrease of the sum of impulses flowing to the hypothalamus from the cold receptors of the skin. G.G.

N65-13689* National Aeronautics and Space Administration, Washington, D.C.
THE TIME RESERVE IN STEADILY DECREASING ALTITUDE
L. S. Isaakyan *In its* Aviation and Space Med. Dec. 1964 p 177–179 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The time reserve that ensures retention of conciousness in hypoxia is studied. This study begins with the subject's reaching a given altitude quickly, and continues until the appearance of the earliest signs of oxygen deficiency, followed by a rapid emergency descent to an altitude of 4.5 km as soon as the first signs of acute hypoxia appear. Various biological parameters were measured to detect the state of altitude syncope. Eighty-four control experiments were performed on nine dogs to determine the static time reserve (time before losing consciousness) at 9-, 10-, and 11-km altitudes. The ratios of static time reserves for the dogs at the three altitudes were the same as the corresponding ratios for human beings at the same altitudes. Forty-seven experiments were performed on the same nine dogs to determine the relationships between static and dynamic time reserves. It is supposed that relationships between static and dynamic time reserves in dogs also have their counterparts in man. D.E.W.

N65-13691* National Aeronautics and Space Administration, Washington, D.C.
SOME RESULTS OF A CLINICAL AND PHYSIOLOGICAL STUDY OF SENIOR PILOTS OF THE CIVIL AIR FLEET
L. S. Isaakyan, D. S. Kuleshov, A. V. Chapek, V. M. Kozin, A. A. Shishova et al *In its* Aviation and Space Med. Dec. 1964 p 184–187 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The reasons for the disqualification of pilots of the Civil Air Fleet were analyzed for age-related pathology. The most important reasons were cardiovascular pathology (mainly atherosclerosis)–33.6%, otolaryngological diseases–9.1%, and changes in vision–7.2%. No connection was found in 51.1% of the cases between the age of pilots and any other pathology that served as a reason for discharge. A group of physically fit pilots was carefully examined using a variety of clinical, X-ray, laboratory, and electrophysiological methods. Special investigations were made of the auditory, vestibular, and visual analyzers, of higher nervous activity, and of visual memory, capacity, and concentration of attention. Results showed that the frequency of X-ray, electrocardiographic, and vectorcardiographic changes in the heart and the speed of pulse-wave propagation increased with age. It was concluded that the chief problems of aging are cardiovascular pathology, changes in visual function, and, in part, occupational changes in hearing. Early diagnosis is recommended. D.E.W.

N65-13692* National Aeronautics and Space Administration, Washington, D.C.
A THEORY CONCERNING GRAVITATIONAL INFLUENCES ON THE ORGANISM
P. K. Isakov *In its* Aviation and Space Med. Dec. 1964 p 188–192 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Changes in human physiology, particularly in gas exchange rates, are discussed for conditions of weightlessness and for one or more g-loadings. Reviewed data indicate that the rate of gas exchange rises sharply during acceleration and returns to normal after the transitional period. The threshold perception of gravity was also investigated, with the subjects' arms immobilized or free, and it was found that the differential threshold of perception of gravity decreases during weightlessness. D.E.W.

N65-13693* National Aeronautics and Space Administration, Washington, D.C.
EFFECT OF HYPOKINESIA ON CERTAIN INDEXES OF EFFICIENCY AND RESPIRATORY FUNCTION IN MAN
L. A. Kakurin, B. S. Katkovskiy, A. N. Kozlov, and N. M. Mukharlyamov *In its* Aviation and Space Med. Dec. 1964 p 192–194 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

An experimental investigation on four healthy young males showed that 20 days in bed caused marked deterioration of human physical fitness. This deterioration was partly from hypokinesia and partly from the body's adaptation to a horizontal position. Also, the deterioration of work efficiency after remaining in bed made heavy demands on the cardiovascular and respiratory systems. D.E.W.

N65-13695* National Aeronautics and Space Administration, Washington, D.C.
REACTIONS OF ASTRONAUTS TO BRIEF PERIODS OF WEIGHTLESSNESS
I. M. Kas'yan *In its* Aviation and Space Med. Dec. 1964 p 198–200 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

An investigation of the responses and performance of astronauts during a short, parabolic, "weightless" flight in an aircraft is reported. Results for each measured parameter are discussed separately. Brief mention is made of astronauts' sensory reactions during weightlessness. Astronauts Gagarin, Titov, Nikolayev, and Popovich were the subjects for these studies. D.E.W.

N65-13696* National Aeronautics and Space Administration, Washington, D.C.
PATHOMORPHOLOGICAL VISCERAL CHANGES IN ANIMALS AFTER ACCELERATIONS
M. I. Kas'yanov and G. P. Mirolyubov *In its* Aviation and Space Med. Dec. 1964 p 201–204 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A study of the effects of a shock overload or acceleration on rats and dogs is reported. The accelerations used caused tissue injury and hemorrhages in organs, fat embolism, and a morphological picture similar to that of concussion of the brain together with degenerative changes in the ganglion cells. Traumas and focal hemorrhages developed in different parts of the organs, depending on the direction and intensity of the acceleration, on the striking of organs against the wall of cavities, and on their consistency and relative position. Reactive changes around the injured areas and focal hemorrhages as well as destructive changes in the lungs and kidneys developed later. In cases of repeated exposure, the possibility of cumulative effects as a result of repeated microinjuries stresses the need to reduce the permissible limits of accelerations on landing. D.E.W.

N65-13698* National Aeronautics and Space Administration, Washington, D.C.
TRACE PHENOMENA IN THE CENTRAL NERVOUS SYSTEM AFTER PROLONGED OPTOKINETIC STIMULATION
V. A. Kislyakov and V. P. Neverov *In its* Aviation and Space Med. Dec. 1964 p 205–206 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Experiments on rabbits to determine the characteristics of optokinetic nystagmus after prolonged (1 and 1/2 hours) optokinetic stimulation are reported. It is concluded that reverse postoptokinetic nystagmus, which is characteristically directed to the side opposite optokinetic nystagmus, is caused by prolonged circulation of excitation in the brain structures. These properties of reverse postoptokinetic nystagmus make it possible to regard the phenomenon as a physiological model for studying the neural mechanisms of illusory reactions. D.E.W.

N65-13699* National Aeronautics and Space Administration, Washington, D.C.
CHANGES IN ELECTRIC ACTIVITY OF THE CEREBRAL CORTEX AND SUBCORTICAL FORMATIONS IN ANIMALS EXPOSED TO BRIEF PERIODS OF WEIGHTLESSNESS AND ACCELERATION
A. M. Klochkov *In its* Aviation and Space Med. Dec. 1964 p 206–209 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Changes in the bioelectric activity of different parts of the brain of animals exposed to brief periods of weightlessness and acceleration were studied. Electric activity was recorded in the following regions of the cerebral cortex: the anterior portion of the suprasylvian and ectosylvian gyri, the vital tissue zone, and the orbital zone. A partial amplitude analysis of the bioelectric activity of the cerebral vortex revealed that the magnitude of the changes differed from zone to zone. The most characteristic and pronounced changes were found in the cortical projection of the vestibular function and in the anterior portion of the suprasylvian and ectosylvian gyri. Patterns of changes in electrical activity are described. D.E.W.

N65-13700* National Aeronautics and Space Administration, Washington, D.C.
SOME SENSORY DISTURBANCES IN PERSONS EXPOSED TO WEIGHTLESSNESS
L. A. Kitayev-Smyk *In its* Aviation and Space Med. Dec. 1964 p 209–210 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Recordings were made of sensory, autonomic, motor, and other reactions of a group of subjects exposed to weightlessness for short periods of time. Observations of the following are presented for fliers and nonfliers: spatial illusions; visual reactions such as optical illusions, heightened color perception, and visual acuity; ataxia; kinesthesia; and time perception. Results show that weightlessness may impair the functioning of various sensory systems in man. D.E.W.

N65-13701* National Aeronautics and Space Administration, Washington, D.C.
THE BODY POSITION (POSTURAL REACTIONS) OF ANIMALS IN WEIGHTLESSNESS
L. A. Kitayev-Smyk *In its* Aviation and Space Med. Dec. 1964 p 211–212 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The behavior of various animals—fish, birds, and mammals—was studied during brief periods of weightlessness. It was found that, at the onset of weightlessness, fish lose ability to orient in relation to the top and bottom of the aquarium. Birds demonstrate a motor reaction resembling continuous upward flight, followed in the second or third period of weightlessness by calm suspension in a characteristic position with wings spread back. Mammals show high motor activity. An investigation of the effect of excluding visual and vestibular analyzers on the behavior of rabbits and the time they took for adaptation to weightlessness is reported. The residual vestibular sensation, the nature of the turning reaction, and the reaction to progressive movements in rabbits and cats

are discussed. The occurrence of general excitation and heightened motor activity in various animals during weightlessness indicates that this factor is an adverse stimulus primarily affecting the vestibular apparatus, and that vision is the decisive factor in developing adaptation to weightlessness. D.E.W.

N65-13702* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF CENTRIFUGAL ACCELERATIONS ON THE VENOUS OUTFLOW IN THE CEREBRAL BLOOD VESSELS OF ANIMALS

V. Ya. Klimovitskiy *In its* Aviation and Space Med. Dec. 1964 p 213–214 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

In continuing experiments with rabbits, venous outflow from the brain during centrifugal acceleration was investigated in the anterior sagittal sinus and major veins on the surface of the brain. Blood flow was recorded as the volumetric flow rate by means of temperature-sensitive elements, consisting of a microthermal resistance and heater, placed on both sides of the blood vessel. Centrifugal acceleration was produced in a head–pelvis direction in a centrifuge with a small arm and fixed number of revolutions per minute. Results of the first and subsequent centrifugations are contrasted. Daily decreases in blood outflow are reported for animals that were initially well conditioned, and inadequacy of blood supply to the brain is reported after the accelerations. Cerebral blood flow reaction to acceleration is said to be simply a passive, mechanical shifting of blood toward the centrifugal acceleration. In most cases, the temperature of the brain surface at the point where the temperature-sensitive element was placed changed in a very stereotyped fashion during centrifugation. D.E.W.

N65-13703* National Aeronautics and Space Administration, Washington, D.C.

PATHOGENESIS OF HEMODYNAMIC DISORDERS AFTER EXPOSURE TO A SUPERSONIC AIR STREAM

A. F. Kovalenko, Ye. Ya. Kaplan, V. P. Boyarkin, and A. M. Klochkov *In its* Aviation and Space Med. Dec. 1964 p 214–217 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

An investigation of the changes effected in the cardiovascular and nervous systems by exposure to a supersonic airstream is reported. The effect of a 1600 km/hr airstream was studied on dogs whose arterial pressure, rate of blood flow, rate and rhythm of cardiac contractions, EKG, and the functional states of the brainstem centers and the sympathetic and parasympathetic nervous systems were recorded. A series of experiments is reported showing the effects of the airstream on animals with electrodes implanted in various cortical and subcortical regions. Other data indicate marked changes in excitability and conduction of the heart muscle after exposure to a supersonic airstream. Under the influence of loud sound (120 dB), the pressor reaction to constriction of the common carotid arteries becomes more pronounced than at the beginning. The airstream caused a 20% to 30% decrease in the pressor reaction below the original level. The excitability of the respiratory center underwent a similar two-phase change. The functional states of the sympathetic and parasympathetic nervous systems following sound and air exposures are reported. D.E.W.

N65-13704* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF HYPOTHERMIA ON OXYGEN DEFICIENCY AT HIGH ALTITUDES

Ye. A. Kovalenko, V. I. Korol'kov, and Ye. A. Il'in *In its* Aviation and Space Med. Dec. 1964 p 217–220 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Experiments were performed on dogs with platinum electrodes implanted in brain tissue to obtain continuous recording, by an automatic integrating analyzer, of the EKG, pneumogram, electrocorticogram, and electrothalamogram. The partial pressure of oxygen in the brain was continuously recorded by the polarographic method in order to study the rate of deoxygenation of brain tissues. Conclusions drawn include: Shallow hypothermia (30° to 32° C) of animals quickly elevated to high altitudes does not increase the time before respiratory arrest and does not prolong survival time at these altitudes. Deeper hypothermia (2° to 23° C) helps to increase the time before respiratory standstill, but by no more than 5 minutes at an altitude of 15 000 m, and by no more than 2 minutes at 27 000 m. D.E.W.

N65-13705* National Aeronautics and Space Administration, Washington, D.C.

EFFECT ON BRAIN OXYGENATION OF BREATHING OXYGEN DURING ACCELERATIONS

Ye. A. Kovalenko, V. L. Popkov, and I. N. Chernyakov *In its* Aviation and Space Med. Dec. 1964 p 220–223 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Experiments performed on dogs with platinum electrodes chronically implanted in brain tissue are reported. The partial pressure of oxygen, pO_2, was determined by the polarographic method in relative values. At the same time the EKG, pneumogram, and EEG were recorded. Accelerations from 2 to 12 g were produced by revolving the animals in a centrifuge for 1 to 3 minutes in longitudinal and lateral directions. Nineteen dogs were rotated 230 times. The investigation showed that prolonged accelerations invariably decrease brain oxygenation, expecially when applied in a head–pelvis direction. This suggests that oxygen deficiency of the brain is important in the pathology caused by accelerations. Further evidence is provided by the fact that breathing oxygen helps to keep pO_2 on a level close to the original, even with accelerations of up to 10 g, and greatly increases the tolerance of accelerations. D.E.W.

N65-13706* National Aeronautics and Space Administration, Washington, D.C.

MORPHOLOGICAL LABYRINTHINE CHANGES IN DOGS EXPOSED TO RADIAL ACCELERATIONS

R. Ye. Kogan and S. S. Makaryan *In its* Aviation and Space Med. Dec. 1964 p 223–227 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Accelerations of varying intensity and duration applied in head–pelvis and pelvis–head directions were found to produce hemorrhages in the middle and inner ears of animals. Middle-ear hemorrhages occurred mainly in the perilymphatic spaces of the cochlea and the sacculus. No middle- or inner-ear hemorrhages were found in dogs that died during an experiment in which the rotation axis passed through the cardiac region. D.E.W.

N65-13707* National Aeronautics and Space Administration, Washington, D.C.

SPEECH AUDIOMETRY AS A METHOD OF FUNCTIONAL DIAGNOSIS IN FITNESS EXAMINATIONS OF FLIGHT PERSONNEL

V. M. Kozin *In its* Aviation and Space Med. Dec. 1964 p 227–230 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A method of speech audiometry is described which is of value in selecting persons suitable for work under noise and vibration conditions and in instituting preventive measures for persons already working under such conditions. The apparatus, composed of a tape recorder, an attenuator, telephones with rubber earpieces, a speech audiometer, and a portable sound-suppressing chamber, is described in detail. The procedures are described, and the word lists and their construction are discussed. The word lists were divided into three categories according to acoustic frequency. For normal hearing, the thresholds of intelligibility for 80% of the words were taken to be 8 dB above the tonal threshold for the general-frequency word group, 13 dB above the tonal threshold for the high-frequency word group, and 18 dB above the tonal threshold for the low-frequency group of words. A comparison with data obtained by whisper audiometry and tonal audiometry shows that this method confirms the findings of tonal audiometry and increases the precision of the whisper audiometry results. D.E.W.

N65-13708* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF FLIGHT FACTORS ON THE ADJUSTING REFLEXES

G. L. Komendantov *In its* Aviation and Space Med. Dec. 1964 p 230–233 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Various factors were studied, such as "elevations" in a pressure chamber, breathing of gas mixtures with low oxygen content, breathing of gas mixtures with little oxygen but high carbon dioxide content, increased pressure in the cavities of the gastrointestinal tract (simulation of altitude meteorism), constriction of the common carotid artery (anemia), and intense and prolonged accelerations. It was found that postrotation nystagmus is slowed in rabbits elevated in a pressure chamber to about 5 km. The addition of carbon dioxide (4.2% to 5.8%) to gas mixtures deficient in oxygen (corresponding to altitudes of 9 to 17 km) generally increased altitude resistance in rabbits; the decrease in eye muscle tone was not very sharp or was not observed at all. Experiments simulating altitude meteorism showed that gastrointestinal inflation caused ocular caloric nystagmus to slow. Results are also reported for experiments that studied the other factors listed. D.E.W.

N65-13709* National Aeronautics and Space Administration, Washington, D.C.

SOME RESULTS OF A STUDY OF THE CARDIOVASCULAR SYSTEM IN FLIERS ON DIFFERENT FLIGHTS

S. Ye. Komshalyuk *In its* Aviation and Space Med. Dec. 1964 p 233–235 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Experiments revealed that cardiovascular changes in airmen during flight depend largely on the complexity of the mission and on the degree of "newness" of the flight. The cardiovascular system was found to experience considerable strain during complex flight missions and in the course of gaining familiarity with new airplanes. In connection with pilot familiarization with new planes or execution of complex flight assignments, it is recommended that aviation physicians give both preflight and postflight physical examinations to study the nature and time of restoration of normal physiological functions, with focus on the cardiovascular system. D.E.W.

N65-13710* National Aeronautics and Space Administration, Washington, D.C.

HISTOMORPHOLOGICAL CHANGES IN DOG PANCREAS AFTER EXPOSURE TO LATERAL ACCELERATIONS

Yu. N. Kopayev *In its* Aviation and Space Med. Dec. 1964 p 235–237 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Two series of experiments were performed with 28 male dogs. The first series studied the effect of 8-g accelerations in a chest–back direction for 3 minutes. The second series studied the effect of 12-g accelerations in the same direction for 1 minute. Five intact animals of the same sex and weight served as controls. The animals were sacrificed 1 hour, 1, 3, 7, 15, 30, and 60 days after exposure—2 animals at each time. The main pancreatic changes that followed single lateral accelerations of 8 and 12 g were disorders caused by the impairment of blood circulation. In addition, definite degenerative–dystrophic changes in the parenchyma of the pacreas were noted shortly after exposure. These subsequently gave way to phenomena of a compensatory–restorative nature. The various changes that arose in the pancreas after the accelerations were all adequately compensated within 30 days of exposure. D.E.W.

N65-13711* National Aeronautics and Space Administration, Washington, D.C.

THE LATENT FORM OF MOTION SICKNESS

V. I. Kopanev *In its* Aviation and Space Med. Dec. 1964 p 238–240 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Experiments are reported in which subjects were placed in a darkened room for over 50 minutes. After stabilization of the excitability and lability indices of their visual analyzers was attained, various subjects were swayed at the rate of 16 to 17 per minute with an intensity of less than 0.15 g. Most subjects with the latent form of motion sickness exhibited a decrease in excitability and lability of the visual analyzer and slight changes in blood pressure and the cardiac rate. A definite relationship was detected between these changes and the degree of statokinetic tolerance. D.E.W.

N65-13713* National Aeronautics and Space Administration, Washington, D.C.

WEIGHTLESSNESS FROM THE STANDPOINT OF TERRESTRIAL PHYSIOLOGY

P. A. Korzhuyev *In its* Aviation and Space Med. Dec. 1964 p 242–244 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The relationship of gravity and biological development is explored. Strong emphasis is placed on the correlations found among degrees of activity in terrestrial vertebrates, their size, their habitat, and the relative sizes of the bodily organs devoted to hemoglobin synthesis. It is suggested that the vigor of the centers of hemoglobin synthesis is dependent to some extent on the gravitational field and that, if the organism were to live in a gravity-free environment, the bone marrow activity would become depressed. D.E.W.

N65-13715* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF LATERAL ACCELERATIONS ON DOG LUNG HISTOLOGY

Yu. N. Korolev *In its* Aviation and Space Med. Dec. 1964 p 247–249 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Two series of experiments were performed on 28 male dogs weighing 10 to 15 kg. The first consisted of a single acceleration of 8 g in a back–chest direction for 3 minutes, the second

consisted of a single acceleration of 12 g in a back–chest direction for 1 minute. The animals were sacrificed 1 hour, 1, 3, 7, 15, 30, and 60 days later. Lung tissues were removed, fixed, and examined. Hyperemia, edema of lung tissue, and hemorrhages, all indicative of impaired pulmonary circulation, were among the early changes observed. From 3 to 7 days after the experiment, inflammatory phenomena developed. Still later, there was focal sclerosis of lung parenchyma due to organization of the previously existing hemorrhages or to pneumonia. These changes did not affect the respiratory function significantly. Compensation was quite pronounced. D.E.W.

N65-13716* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF LATERAL ACCELERATIONS ON DOG KIDNEY HISTOLOGY

V. V. Korolev *In its* Aviation and Space Med. Dec. 1964 p 249-252 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Two series of experiments were performed on 28 male dogs weighing 10 kg to 15 kg. The first consisted of a single acceleration of 8 g for 3 minutes, and the second consisted of a single acceleration of 12 g for 1 minute. Two animals from each series were sacrificed with ether fumes 1 hour, 3, 7, 30, and 60 days after the acceleration. Kidney tissues were removed and stained for examination. During the first few hours and days after the experiments, venous hyperemia and focal hemorrhages around the glomerulia and between the tubules were noted. Increased permeability of the walls of the capillaries of the vascular glomeruli was indicated by the erythrocytes found in the lumens of the tubules. The hemorrhages that appeared after 7, 15, and 30 days were apparently caused by increased vascular permeability and decreased neurovascular tone, which may have resulted from the ether fumes. The morphological changes were more pronounced in the first series of experiments than in the second, especially those in the vascular system. D.E.W.

N65-13717* National Aeronautics and Space Administration, Washington, D.C.

PSYCHOLOGICAL AND PHYSIOLOGICAL CHARACTERISTICS OF THE WORK OF AIRPLANE CREWS IN CONNECTION WITH IN-FLIGHT REFUELING

F. P. Kosmolinskiy *In its* Aviation and Space Med. Dec. 1964 p 252–254 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Changes in aircrew cardiac rates and respiratory rates by factors of 2 to 3 during in-flight refueling are reported. Changes after long flights included weight loss, muscle strength reduction, muscular endurance reduction, and various nervous and mental changes. Increasing the skill of pilots clearly improved the nervous and emotional strain manifestations. Changes induced by emotional excitement and strong nervous stress are enumerated. The metabolism of vitamins (especially vitamin C), cholesterol, and corticosteroids is discussed in relation to stress. Increased urinary ascorbic acid excretion was found in fliers whose work entailed extreme nervous and emotional and physical strain, while no such changes were noted for others members of the same crew who had less responsible jobs. An exceptionally high elimination rate of ascorbic acid (from 5 to 30 times above normal) is reported for fliers after high strain, whether they received diets with extra vitamin C or not. It is concluded that physiological and biochemical changes noted in the personnel after long flights with refueling in the air are directly related to the complexity of the mission. D.E.W.

N65-13718* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF PROLONGED LATERAL ACCELERATIONS ON MONKEYS

A. R. Kotovskaya, P. V. Vasil'yev, B. A. Lapin, S. F. Simpura, I. S. Grishina et al *In its* Aviation and Space Med. Dec. 1964 p 254–257 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The cardiovascular and respiratory reactions to chest–back accelerations were investigated with 11 rhesus monkeys and 5 baboons, and the duration of tolerance of 12-g accelerations was determined. The apparatus, instrumentation, procedures, and detailed observations are described. In general, the behavior and condition of the animals before, during, and after rotation and the results of cardiac and respiratory checks showed that monkeys can tolerate accelerations of 12 g in a chest–back direction for 1 to 4 1/2 minutes. Analysis and comparison of the data with observations on human beings indicate that monkeys show promise for studying the pathogenesis of many functional disorders caused by accelerations. D.E.W.

N65-13719* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF ACCELERATIONS ON LIVER STRUCTURE

Ye. F. Kotovskiy *In its* Aviation and Space Med. Dec. 1964 p 257–259 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The results of a histological study of the liver of animals subjected to lateral accelerations under specified conditions are given. Twenty-eight male dogs (2 groups of 14 animals each) weighing 10 to 15 kg were used. The first group was subjected to 8-g accelerations in a chest–back direction for 3 minutes; the second group, to 12-g accelerations in the same direction for 1 minute. Five dogs served as controls. Two animals were sacrificed 1 hour, 1, 3, 7, 15, 30, and 60 days after the experiment. Fragments of liver were taken from the ventral, central, and dorsal portions of the left lobe, and fixed and treated for examination. The first and second groups showed similar morphological and histological liver changes, essentially of two kinds: vascular changes, and changes in hepatic cells and bile duct cells. The progress of the dogs over the 60 days following is traced histologically. It is stated that the changes in both groups of dogs were similar, although they varied in intensity. The scale of the changes was far greater in the dogs of the second group. D.E.W.

N65-13720* National Aeronautics and Space Administration, Washington, D.C.

THE USE OF HYPERVENTILATION IN SELECTING CANDIDATES FOR FLYING SCHOOL

A. K. Kochetov *In its* Aviation and Space Med. Dec. 1964 p 260–262 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A hyperventilation test with simultaneous EEG recording is decribed that can be of value in detecting rather delicate CNS impairments and in identifying persons with low tolerance of hypocapnia. The latter is important in flying because of possible decreased pilot efficiency at times of great emotional stress. In the hyperventilation syndrome, no clear-cut relationship was noted between subjective sensations and brain bioelectric changes. A wide variety of changes occured in the EEG's examinees experiencing the disagreeable sensations characteristic of hypocapnia. D.S.G.

N65-13721* National Aeronautics and Space Administration, Washington, D.C.

PRINCIPLES GOVERNING THE OBJECTIVE EVALUATION OF THE THERMAL STATE OF THE BODY

V. I. Krichagin *In its* Aviation and Space Med. Dec. 1964 p 262–266 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

In evaluating the airman's body reserves in flight, an index of his thermal state is essential. Data are presented that can be used as criteria for evaluating the body's heat state. The gradations of thermal states described are: (1) comfortable state or complete absence of subjectively sensed information, (2) mild sensations evaluated as cool, (3) distinct sensation of general coolness, and (4) definite sensation of very cold. Similar differentiations are made for states of overheating. Criteria used include net weight loss by perspiration, skin appearance, rectal and axillary temperature, skin temperature, difference between trunk and extremity temperature, and general physiological indexes (pulse, respiration, and metabolism). D.S.G.

N65-13722* National Aeronautics and Space Administration, Washington, D.C.

CHANGES IN SOME PHYSIOLOGICAL FUNCTIONS RESULTING FROM EXPLOSIVE DECOMPRESSION

A. G. Kuznetsov, A. S. Tsivilashvili, and A. R. Mansurov *In its* Aviation and Space Med. Dec. 1964 p 267–269 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

In this study of physiological effects of large and rapid pressure drops, dogs and rabbits were placed in a chamber in which the barometric pressure was greatly reduced within 0.3 to 0.004 second, and the following parameters were measured: respiration rate and rhythm, biopotentials of respiratory muscles, EKG, arterial blood pressure, and action currents from the diaphragm and vagus nerves of anesthetized dogs and nonanesthetized rabbits. In addition, roentgenography and cinefluorography of thoracic and abdominal organs, and roentgenokymography of the diaphragm and ribs of the intact animals were performed. The data show that explosive decompression causes major changes in a very short time, that these changes are reflex in nature, and that they vary with the type of decompression. D.S.G.

N65-13723* National Aeronautics and Space Administration, Washington, D.C.

CHANGES IN RESPIRATORY AND CARDIOVASCULAR FUNCTIONS AFTER PROLONGED EXPOSURE TO LOW BAROMETRIC PRESSURE

A. G. Kuznetsov, N. A. Agadzhanyan, Yu. P. Bizin, N. I. Yezepchuk, I. R. Kalinichenko et al *In its* Aviation and Space Med. Dec. 1964 p 270–272 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The dynamics of gas exchange, cardiovascular function, and peripheral blood supply were studied in two subjects after extended exposure to low barometric pressure (308 mm Hg) with normal partial pressure of oxygen (150 to 160 mm Hg). Among the effects noted were reduced oxygen utilization, reduced amount of heat emitted, decreased cardiac rate, decreased arterial blood pressure, and only very slight hematological changes. It was concluded that the physiological changes were largely due to hypodynamia which caused the metabolic level to drop; this was substantiated by the fact that the gas exchange function returned to normal 8 to 10 days after the end of the experiment. D.S.G.

N65-13724* National Aeronautics and Space Administration, Washington, D.C.

CHANGES IN THE VECTORCARDIOGRAM OF FLIGHT PERSONNEL IN EARLY STAGES OF HYPERTENSION

Ye. I. Kuznetsova *In its* Aviation and Space Med. Dec. 1964 p 272–274 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The use of vectorcardiography in evaluating the condition of the cardiovascular system was studied using data on 55 fliers, 30 to 49 years of age, of whom 25 were normal and 30 had a diagnosis of the first stage of hypertension. Vectorcardiograms were first analyzed by comparing them with electrocardiographic data and data from X-ray examination, then recorded by the five-plane system of Akulinchev. Tabulation of the results showed that the average value of the maximum vector of the QRS loop in hypertensive patients has a tendency to increase in all five planes. This is attributed to an increase in the difference of the bioelectric field of the myocardium. D.S.G.

N65-13725* National Aeronautics and Space Administration, Washington, D.C.

EKG CHANGES IN FLIGHT PERSONNEL AFTER PROLONGED NONSTOP FLIGHTS

N. M. Kulikova *In its* Aviation and Space Med. Dec. 1964 p 274–277 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Changes in the cardiovascular systems of flight personnel who were carrying out 8- to 9-hour nonstop trips in turboprop planes were determined by the EKG method. The EKG's were recorded 1 hour after the plane landed, after a 24-hour rest, and after a 2- to 3-day rest. The following conclusions were drawn from the generalized results: (1) EKG indexes in all crew members after prolonged nonstop flights do not exceed normal physiological limits. (2) The lowering of the functional capacity of the myocardium was more marked in cabin captains than in the other crew members. (3) Changes noted in the EKG's after flights were of a functional nature, since after 24 hours of rest the observed shifts were fewer, and after 2- to 3-days rest they had completely disappeared. (4) The temporary changes are regarded to be the effects of fatigue resulting from stresses of prolonged nonstop flights. D.S.G.

N65-13726* National Aeronautics and Space Administration, Washington, D.C.

PARTICIPATION OF L. A. ORBELI IN THE DEVELOPMENT OF THE PROBLEM OF COSMIC PHYSIOLOGY

A. V. Lebedinskiy *In its* Aviation and Space Med. Dec. 1964 p 277–283 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

At a conference on stratosphere studies held in the U.S.S.R. in 1935, L. A. Orbeli proposed a number of solutions to fundamental problems which are still important to research workers in the field of space biology and medicine today. Emphasis is placed on Orbeli's proposed plans of research involving active injection of a scientist into the stratosphere (the cosmic space of present time); studies of the interaction of afferent systems; and studies of the effects of cosmic radiation on man. D.S.G.

N65-13728* National Aeronautics and Space Administration, Washington, D.C.

THE PROLONGED EFFECT OF SLOW CORIOLIS ACCELERATIONS ON THE HUMAN ORGANISM

A. V. Lebedinskiy, N. I. Arlashchenko, V. Ye. Busygin, R. A. Vartbaronov, A. S. Veselov, et al *In its* Aviation and Space Med. Dec. 1964 p 289–292 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Coriolis acceleration effects on humans were studied in a closed chamber rotating at constant angular speeds of 5.3°, 10.6°, and 21.2° per sec for periods up to 24 hours. Test subjects were seated in armchairs within the chamber, and the Coriolis acceleration was produced by periodically tilting the body and head in planes perpendicular to the chamber rotation at the rate of one movement per second. Functional changes in the CNS and cardiovascular system, disruptions of thermoregulation and equilibrium functions, and vegetative disorders occurred in direct proportion to increases in rotation speed and duration. After several hours in the chamber, adaptation occured with alleviation of these disorders in all subjects except those with a very low tolerance to vestibular stimulation. Such lengthy, slow rotation is recommended as an astronaut training procedure. M.P.G.

N65-13729 * National Aeronautics and Space Administration, Washington, D.C.

LABOR HYGIENE AND OCCUPATIONAL PATHOLOGY INVOLVED IN THE WORK WITH CENTIMETER WAVE GENERATORS IN THE CIVIL AIR FLEET

A. Ya. Loshak *In its* Aviation and Space Med. Dec. 1964 p 292–295 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The causes of uhf irradiation of the engineering and technical personnel of a radar station are assessed, and the factors influencing the amount of radiation received by such personnel are considered, including the length of the working day, the height and angle of elevation of the antennas, and the wavelengths at which the station is operating. The symptoms associated with uhf radiation are discussed briefly, and a number of procedures are proposed to shield radar station personnel from the uhf field M.P.G.

N65-13730* National Aeronautics and Space Administration, Washington, D.C.

THE VIBRATION AND RADIATION EFFECT ON THE ACIDIFYING PROCESSES IN THE BRAIN TISSUES OF RATS

L. D. Luk'yanova *In its* Aviation and Space Med. Dec. 1964 p 296–297 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The partial oxygen pressure or tension (pO_2) in various sections of the brain was measured by the oxygen cathode method of polarographic analysis. Vertical vibration produced an immediate sharp increase in the consumption of oxygen, followed by reduced consumption lasting 2 hours, followed by normalization of the process. In animals subjected to repeated vibrations, the brain consumption of oxygen during the vibration increased faster and diminished more slowly. The changes in consumption rates were most conspicuous in the motor region of the cerebral cortex. Irradiated animals revealed a decreased oxygen consumption immediately after their exposure, but such consumption was back to normal 1 to 2 days later. Animals subjected to vibration followed by irradiation revealed a predominance of the vibration effect. R.L.K.

N65-13731* National Aeronautics and Space Administration, Washington, D.C.

AN ELECTROENCEPHALOGRAM OF AN ACUTE HYPOXIC (sic) HYPOXIA

V. B. Malkin *In its* Aviation and Space Med. Dec. 1964 p 297–301 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

In order to determine the diagnostic significance of the various electroencephalographic changes, the clinical picture of developing hypoxia was correlated with the EEG changes. The clinical picture included electrocardiograms, recording of respiratory movements, arterial blood pressure, and determination of the oxygen saturation of the arterial blood. An accompanying psychophysiological examination included a study of the rate of simple conditioned motor reactions, the recording of a memorized test, the solution of simple arithmetic problems, and a recording of the general subjective feeling. Results established that the initial symptoms of disrupted CNS activity in moderate hypoxia can occur while the EEG remains within the norm. The type and sequence of EEG changes produced by the development of acute hypoxia-connected disturbances of the CNS are described in detail. R.L.K.

N65-13732* National Aeronautics and Space Administration, Washington, D.C.

THE CHARACTERISTIC FEATURES OF THE CLINICAL COURSE AND THE EXPERT'S OPINION OF FLIGHT PERSONNEL AFFLICTED WITH STOMACH AND DUODENAL DISEASES

Ye. T. Malyshkin and B. L. Gel'man *In its* Aviation and Space Med. Dec. 1964 p 301–303 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A study of all data obtained from case histories of 310 persons, 124 of whom suffered from ulcers and 186 from chronic gastritis, as well as examination data on 88 ulcer patients and 101 chronic gastritis patients, failed to reveal any obvious direct connection between the diseases and the effect of specific factors characteristic of the flying profession, or of the intensity and duration of flying. Examination of the secretory activity of the stomach glands on a number of these patients revealed a continuing high level of acidity and secretion, which is explained by the intensified regeneration and hyperplasia of the glandular apparatus. A study of the characteristic features of the higher nervous system by the method of conditioned reflexes revealed pronounced differences in the cortical processes: the greatest disruptions were found in people suffering from chronic gastritis and ulcers in an aggravated stage, while those in the remission stage had established a partial or complete normalization of the cortical processes. D.S.G.

N65-13733* National Aeronautics and Space Administration, Washington, D.C.

ON THE DIAGNOSIS AND EXPERT MEDICAL OPINION OF FLIGHT PERSONNEL AFFLICTED WITH ATHEROSCLEROSIS

Ye. T. Malyshkin, N. A. Gol'din, and V. M. Tolstov *In its* Aviation and Space Med. Dec. 1964 p 303–305 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Several complex clinico-physiological instruments and laboratory procedures for diagnosis of early stages of atherosclerosis were studied to establish criteria in the selection of flying personnel. The diagnostic complex included: (1) determination of metabolic changes by examining the protein fractions of blood serum, cholesterol and its fractions, the lecithin–cholesterol index, the lipoproteins, thyroid gland functions, basal metabolism, and penetrability of the vessels; (2) electrocardiogram, ballistocardiogram, and vectorcardiogram examinations; and (3) determination of propagation rate of the pulse wave, piezography, and rheovasography from the lower extremities. Conclusions relating to the acceptance of flight personnel showing latent artherosclerosis are presented. D.S.G.

N65-13734* National Aeronautics and Space Administration, Washington, D.C.

VESTIBULAR REACTIONS UNDER THE EFFECT OF VARIOUS ANGULAR ACCELERATIONS

S. S. Markaryan *In its* Aviation and Space Med. Dec. 1964 p 305–308 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The effect of angular accelerations on 13 normal subjects at various body tilts was studied, and the following conclusions were drawn: (1) The duration and intensity of the nystagmic reaction produced by the effect of angular accelerations on man depend on the position of the body in relation to the vertical rotation axis; the nystagmus gradually diminishes with the increasing angle of body inclination (from 0 to 90°), while the sensory reaction continues in the form of a counterrotation illusion. (2) In the first 30 minutes or more of the nystagmic reaction it is impossible to read the aerial navigation instruments or the signs on the choline table. (3) An upset body equilibrium in various degrees is found in the majority of the test subjects. (4) Changing the position of the head during or after the rotation produces vestibulo-vegetative reactions in persons with a higher vestibular sensitivity. (5) The use of repeated effects of angular accelerations may be recommended for the purpose of training flight personnel in use of the vestibular analyzer. Author

N65-13735* National Aeronautics and Space Administration, Washington, D.C.

REACTIVE CHANGES IN THE INGUINAL LYMPH NODES UNDER THE EFFECT OF VARIOUS OVERLOADS ON THE ORGANISM OF DOGS

Yu. V. Mashkovtsev *In its* Aviation and Space Med. Dec. 1964 p 309–312 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A study of the effect of G-forces on the inguinal lymph nodes was carried out with dogs subjected to transverse (chest-back) accelerations of varying magnitude and duration. There were two series of tests: 3 minutes under an 8-G load factor, and 1 minute under a 12-G load factor. The tests involved 28 mongrel dogs, all of which had been immunized against the plague 2 weeks before the tests. The animals were sacrificed 1 hour, 24 hours, 3, 7, 15, 30, or 60 days after the G-force effect. The lymph nodes were removed, sectioned, and stained, and the areas of centers of hemopoietic activity and the number of mytoses were measured. It was found that the load factors in the first series of tests produced a more powerful effect on the lymphopoietic tissue than the shorter but heavier loads of the second series, and that the destruction of the lymphoid follicles in the first days after the G-force was eventually followed by a regenerative phase. D.S.G.

N65-13736* National Aeronautics and Space Administration, Washington, D.C.

THE DYNAMICS OF THE MORPHOLOGICAL CHANGES IN THE CEREBRAL CORTEX OF DOGS FOLLOWING THE EFFECT OF A TRANSVERSE ACCELERATION

D. I. Medvedev *In its* Aviation and Space Med. Dec. 1964 p 312–315 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Two series of tests were made: in the first, the animals were subjected to a single, transverse 8-g acceleration for 3 minutes, and in the second, to 12-g for 1 minute. One hour, or 1, 3, 7, 15, 30, or 60 days later the dogs were killed and brain samples were taken for microscopic investigations. As an effect of acceleration a larger number of morphohistochemical changes took place in the area of the motor analyzer of the dog's cerebral cortex. Some of the changes (the hemorrhages, for example) were undoubtedly induced by the accelerations, while others reflect the compensatory reactions of the nerve tissue. A few instances of nerve-cell death and an increased number of binuclear cells were examples of definite reactive changes, but the overwhelming majority of changes were of a reversible nature. The changes occurring in the first series of tests were more pronounced but of the same nature as those in the second series. D.S.G.

N65-13737* National Aeronautics and Space Administration, Washington, D.C.

THE EFFECT OF A PROLONGED HYPOKINESIA ON THE HUMAN BLOOD CIRCULATION

A. L. Myasnikov, R. M. Akhrem-Akhremovich, L. I. Kakurin, Yu. T. Pushkar, N. M. Mukharlyamov et al *In its* Aviation and Space Med. Dec. 1964 p 316–318 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A regimen of confinement to bed was used as a method approaching certain hypodynamic and circulatory effects of weightlessness. The test subjects were four men, 22 to 24 years of age, judged to be in perfect health. These men were kept in a horizontal position for 20 days, and allowed to sit up in a spacecraft once every 3 to 4 days. Clinical and physiological tests were made before the experiment, during confinement to bed, after the confinement, and after knee-bend exercises. Details of the examinations are presented. It is assumed that a similar tendency of functional changes of the cardiovascular system will occur in a person returning to terrestrial gravitation after a long period of weightlessness. D.S.G.

N65-13739* National Aeronautics and Space Administration, Washington, D.C.

THE SANITARY ASPECT OF THE WORKING CONDITIONS AROUND ULTRAHIGH FREQUENCY GENERATORS

M. I. Netreba *In its* Aviation and Space Med. Dec. 1964 p 321–324 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Because of numerous complaints about health by service personnel in radar stations, medical examinations were given to all personnel subjected to uhf radiation, and a study of the working conditions at those installations was instituted. It was found that the maximum uhf radiation around dispatchers was 0 to 10 microwatt/cm^2, but that radio technicians tuning and adjusting antenna devices received 60 to 600 microwatt/cm^2. Clinical studies of 10 radio technicians and shift engineers on a longer workday revealed very pronounced functional changes (asthenic and vegetative reactions) in their various organs and systems. Changes in the peripheral blood composition were found in 14 engineers and radio technicians; pronounced changes in the organon visus were found in one case. Organic changes were not found in the cardiovascular and nervous systems of those investigated. Recommendations are made for protective measures. D.S.G.

N65-13740* National Aeronautics and Space Administration, Washington, D.C.

THE ROLE OF THE SINOCAROTID REFLEXOGENIC ZONE IN THE REACTION OF THE BLOOD SYSTEM TO REDUCED BAROMETRIC PRESSURE

Yu. V. Nikolayenkov *In its* Aviation and Space Med. Dec. 1964 p 324–327 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The changes in the peripheral blood and bone marrow of 14 adult male dogs subjected to alternating low barometric pressures in a series of "ascents" in a pressure chamber were

investigated. The results of the tests indicate that the sinocarotid reflexogenic zone is an important link between the reaction of the blood system to the reduced pressure and the related oxygen starvation of the organism. The exclusion of the reflex impulse from the interoceptive zone of the carotid sinuses results in a disruption of the usual reaction of the blood system to hypoxia. It also disrupts the processes of blood formation, distribution, and destruction. D.S.G.

N65-13741* National Aeronautics and Space Administration, Washington, D.C.

EVALUATING SOME OF THE ORGANISM'S REFLEX REACTIONS TO BREATHING UNDER INCREASED INTRAPULMONARY PRESSURE

P. V. Oblapenko *In its* Aviation and Space Med. Dec. 1964 p 328–330 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Breathing under increased intrapulmonary pressure produces reflex reactions to restore normal blood circulation; however, these reflexes are not always compatible and, far from eliminating the hemodynamic disruptions, they may intensify them and lose their adaptive function. Foremost among the reflexes are those that raise the tonus of the peripheral vessels and accelerate the cardiac rhythm; at the same time, other reflexes produce a bradycardia and dilatation of the peripheral vessels. In the initial period of experiments with dogs, the beat volume of the left heart was sharply reduced and tachycardia resulted. Eventually, compensatory reactions began which resulted in decreased output of the heart and reduced arterial pressure. The mechanisms of this reaction of a slower cardiac rhythm occurring under the effect of the parasympathetic nervous system are discussed. D.S.G.

N65-13742* National Aeronautics and Space Administration, Washington, D.C.

STUDYING THE NYCTOHEMERAL RHYTHM OF FUNCTIONS IN CONDITIONS OF LIMITED MOBILITY

N. Ye. Panferova *In its* Aviation and Space Med. Dec. 1964 p 330–333 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The effects of maximum possible limitation of muscular work and body movement on the nychthemeral rhythm of body temperature, pulse frequency, respiration, and blood pressure were investigated. Two series of experiments were conducted using test subjects kept flat on their backs in special armchairs for 2 to 10 days during the first series, and in a lying position in water for 1.5 to 11.5 days during the second. Measurements were taken every two hours. Results indicate that changes occur in the nychthemeral rhythm of the studied functions, particularly body temperature, and that the changes are more pronounced when the test subjects are kept in water. It is concluded that vigorous muscular activity is an important requirement for maintaining the daily functional patterns developed during the course of evolution. D.S.G.

N65-13744* National Aeronautics and Space Administration, Washington, D.C.

PATHOMORPHOLOGICAL CHANGES INDUCED IN ANIMALS BY ROTATING THEM AROUND AXES RUNNING THROUGH THE PELVIC-CARDIAC-CEPHALIC REGION

V. G. Petrukhin *In its* Aviation and Space Med. Dec. 1964 p 336–339 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Autopsies of dogs subjected to lengthy radial acceleration revealed that, regardless of the location of the rotation axis (pelvic, cardiac, or cephalic region) and body tilt angle, considerable changes are produced by overloads exceeding 2.5 g and lasting 20 minutes. Sixfold overloads cause death in almost all cases. The main reasons for the acceleration injuries are apparently the sharp increase in the venous pressure and severe displacement of the organs. The venous pressure increase is caused by blood stasis in the extremities and arterio-venous anastomoses in the lungs, which in turn causes hypoxia of the myocardium and brain, edema, and hemorrhages and necrobiotic changes in all the organs. M.P.G.

N65-13745* National Aeronautics and Space Administration, Washington, D.C.

THE PATHOMORPHOLOGY OF TRANSVERSE OVERLOADS

V. G. Petrukhin and M. M. Sokolova *In its* Aviation and Space Med. Dec. 1964 p 339–342 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Pathomorphological changes in animals subjected to the following transverse accelerations in the chest-back position are described: 8 g for 3 min; 12 g for 1 min; 12 g for 3 min; and 12 g for 3 to 5 min. The nature of the changes observed was identical in all test series, but the second and third series revealed more extensive lesions. Animals sacrificed less than an hour after acceleration showed pooling of blood in the right heart cavities, vena cava, pulmonary arteries, liver, and lungs. Only the lung lesions were macroscopically evident after 8 days. Brain, heart muscle, liver, kidney, and adrenal gland changes are also discussed; the majority were found to be reversible. The effects of acceleration on the brain and myocardium resemble the changes produced by hypoxia. This is considered as further evidence that the effects of transverse acceleration are associated primarily with disruption of blood circulation in the entire organism. M.P.G.

N65-13746* National Aeronautics and Space Administration, Washington, D.C.

SOME PROBLEMS OF THE HUMAN PERSONALITY IN AERONAUTICS, AVIATION AND ASTRONAUTICS

K. K. Platonov *In its* Aviation and Space Med. Dec. 1964 p 342–346 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Personality and its role in flight is discussed historically and philosophically from the first balloon flights, in which man was relatively inactive, to the complexity of present day flight. Early in the history of flight, two distinct approaches to the study of the psyche of a flier became evident—the personal and the functional, both of which are combined with the mechanistic approach. During the 1920's, a swing to a biological or "reflexological" view of the pilot occurred as a result of previous overemphasis on psychotechnical investigations. Two more biological trends occurred as the result of misinterpretations of resolutions adopted at party conferences in 1936 and 1950. As a result, aviation psychology has suffered, and the need still remains for a theory of personality and individual talent in the art of flying. M.P.G.

N65-13747* National Aeronautics and Space Administration, Washington, D.C.

EVALUATING THE EFFECTIVENESS OF THE EXPERIMENTAL METHODS USED IN THE PSYCHOLOGICAL SELECTION OF AVIATION CADETS

B. L. Pokrovskiy, T. I. Zhukova, and V. P. Zukhar' *In its* Aviation and Space Med. Dec. 1964 p 347–349 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The predictability and reliability of methods used to reveal individual psychological characteristics of personality important for the flying profession were investigated. The ratings given the cadets in the prescribed tests were compared with ratings of their actual flying performances. Considerable differences in the correlation ratios were found, varying from high predictability for such tests as addition, switch manipulation, and correction-making to negative predictability for the scales-estimating test. Reliability of the test methods was determined by repeating the investigation on a second group of cadets a year later. Although the results of the entire complex of methods correlated with the quality of flying progress with a 99% probability, the probable correlation based on individual methods was always less than 95%. M.P.G.

N65-13750* National Aeronautics and Space Administration, Washington, D.C.
THE REACTION OF THE ORGANISM TO THE INFORMATIONAL CHARACTERISTIC OF A STIMULUS
V. A. Popov and A. S. Khachatur'yants *In its* Aviation and Space Med. Dec. 1964 p 355–358 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The effect of specific factors on reactions to a variety of stimulus probabilities was studied. A definite logarithmic relationship was found between the length of time the informational significance of the signals was remembered and the magnitude of that significance. There was a progressive reduction in the hidden time of reaction to each signal of the informational complex. In a series of tests of the effects of deleterious factors—prolonged acoustical noise, alcohol, oxygen deficiency, barometric pressure drops, prolonged unchangeable position, etc.—a common factor was a shorter retention period for the informational significance of the signals, but the nature of the memory loss was specific to each factor. R.L.K.

N65-13751* National Aeronautics and Space Administration, Washington, D.C.
ELECTROCARDIOGRAMS IN DOGS DURING EXPOSURE TO CERTAIN ALTITUDE FACTORS
V. L. Popkov and I. N. Chernyakov *In its* Aviation and Space Med. Dec. 1964 p 358–362 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A series of EKG's were taken on 11 dogs subjected (1) to hypoxic hypoxia in a pressure chamber atmosphere with an oxygen deficiency equivalent to an altitude of 9 km, (2) to the effect of respiration of high-pressure sea level and high-altitude atmospheres, and (3) to the effect of a pressure reduction of 0.3 abs atm. The consistent nature of the EKG changes after reduction in ambient pressure, as well as the differences between the EKG's of dogs exposed to excess pressure and those of dogs exposed to hypoxia, indicated that the factors determining these EKG changes were the delivery of excess pressure in barochambers and the resultant alteration in the position of the heart within the chest cavity. It was concluded that the changes in dog EKG's accompanying the respiration of excess pressure atmospheres were the result of physiological adaptation of the organism to its environment and did not exceed the limits of normal EKG variations in dogs. R.L.K.

N65-13752* National Aeronautics and Space Administration, Washington, D.C.
EFFECT OF OXYGEN STARVATION ON MOTION SICKNESS
N. A. Razsolov *In its* Aviation and Space Med. Dec. 1964 p 362–365 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Five subjects were tested for physiological reactions, dynamometric performance, and correction task performance after control tests and after being subjected to rocking under oxygen-starvation conditions. Conclusions are: (1) Rocking by the method of two-fold rotation makes it possible to elicit a latent illusion of rocking in statokinetically stable people and a marked illusion of rocking in less stable persons. (2) During rocking under conditions of oxygen starvation, vegetative reactions are intensified. (3) During both forms of rocking, higher nervous activities are disrupted, apparently at the expense of weakened inner cortex inhibition, causing a poorer quality performance in the correction test and rationed manual dynamometry. (4) Oxygen starvation at 4000-m height apparently results in weakening of the inner inhibition, which is reflected in poor performance of the correction tests. (5) During rocking under conditions of oxygen starvation, a still greater cumulative disturbance of higher nervous activity is observed. R.L.K.

N65-13754* National Aeronautics and Space Administration, Washington, D.C.
SOME REGULAR PATTERNS IN THE EFFECT OF ACCELERATION ON THE ORGANISM
D. Ye. Rozenblyum *In its* Aviation and Space Med. Dec. 1964 p 368–369 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Two basic phases are distinguished in the effects of radial accelerations—the relative compensation phase, and the decompensation phase. In the first, some functions, mostly the vital ones, are intensified, and others temporarily inhibited by way of compensation; thus, the mechanical forces exceed the thresholds of individual stability. This phase is neither perfect nor stable. Since the field of centripetal acceleration is equivalent to the acceleration of earth gravitation, the author concludes that the physiological systems of adaptation to earth gravitation carry the load of the fight against increased gravitation. Study of the decompensation phase permits delineation, in the chain of mutually connected phenomena, of some leading links which normally limit transference of accelerations. R.L.K.

N65-13755* National Aeronautics and Space Administration, Washington, D.C.
THE NERVOUS SYSTEM'S ROLE IN THE ORGANISM'S REACTIONS TO ACCELERATIONS
B. M. Savin *In its* Aviation and Space Med. Dec. 1964 p 370–372 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Disturbances of hemodynamics are prominent indications of changed physiological functioning under increase of artificial gravitation. In these disturbances, the neural reflex reactions are most important. In some cases these reactions are compensatory and promote the equilibrium of the organism under the changed mechanical conditions. In other cases they may facilitate the appearance of even more marked hemodynamic disturbances. These differences in the reflex mechanisms of circulatory regulation are based on shifts in CNS functional state, primarily the condition of the vasculomotor center and the vagus nerve centers. Functional disturbances of the reflex mechanism that regulate the cardiovascular system decrease the organism's capacity for adaptation. In the systematic effect of overloads, the organism's capacity to balance the changed conditions of gravitation increases sharply. R.L.K.

N65-13756* National Aeronautics and Space Administration, Washington, D.C.
ELECTROENCEPHALOGRAPHIC EXAMINATION OF FLIGHT PERSONNEL DURING LONG FLIGHTS
L. V. Sadovnikova *In its* Aviation and Space Med. Dec. 1964 p 372–373 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Analysis of EEG data showed that after 8- to 9-hour flights, flight personnel fully preserved the expression, quantity, and periodicity of the α rhythm. There was a simultaneous drop in voltage of the amplitude of biopotentials (α, β, and others). Lengthened were such EEG indices as depression and latent and restoration periods of the α rhythm after exposure of the eyes to light. The EEG taken after the flight showed no essential changes in the expression of slow waves. Analysis of changes in brain biopotentials led to the conclusion that there is a decreased bioelectrical activity of the cerebral cortex and a decrease in neural mobility with accompanying inhibitory processes. These changes are considered a result of CNS fatigue. Dependence of the aforementioned changes upon fatigue was proved by the time (1.5 to 3 days) required to restore EEG components during rest. Standardized afterflight rest periods were recommended. R.L.K.

N65-13757* National Aeronautics and Space Administration, Washington, D.C.
FUNCTIONAL STATE OF THE VESTIBULAR ANALYZER DURING THE FIRST FEW HOURS FOLLOWING IRRADIATION WITH DIFFERENT DOSES
A. V. Sevan'kayev *In its* Aviation and Space Med. Dec. 1964 p 373–375 ref (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Experiments were done on 120 rabbits with a setup permitting stimulation of the labyrinth, a wide range of angle accelerations and velocities, and objective registration of nystagmus and frequency of respiration and pulse. Before, immediately after, and 2 and 5 hours after, total irradiation of 50, 100, 500, 800, or 5000 r, the threshold sensitivity and reactivity of the vestibular analyzer were tested. The higher doses resulted in the greater loss of analyzer function. However, at the lower doses (50 and 100r), some animals showed an increased response to stimulation. For the most part, the maximum loss was observed 2 hours after irradiation. Five hours afterwards there was some restoration of the initial response, varying by dose. R.L.K.

N65-13758* National Aeronautics and Space Administration, Washington, D.C.
HISTOCHEMICAL EXAMINATION OF THE CHANGES IN THE DISTRIBUTION OF THE EFFECT OF DEHYDROGENASE SUCCINATE, CARBOANHYDRASE, ALKALINE AND ACID PHOSPHOMONOESTERASE, ADENOSINE TRIPHOSPHATASE AND SULFHYDRYL GROUPS OF PROTEINS IN INNER ORGANS IN ACUTE STATE OF OXYGEN STARVATION
S. N. Sergeyev *In its* Aviation and Space Med. Dec. 1964 p 376–379 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Changes in the activity of enzymes due to hypoxia were investigated by comparing simultaneously prepared sections from identical organs in experimental and control animals. The changes observed included relative inhibition of intensification of the activity, or sometimes both decreased and increased activity in different portions of the same organ. These reactions to the disruption of the oxygen supply were extremely rapid, developing much earlier than changes in the sulfhydryl groups of proteins. R.L.K.

N65-13759* National Aeronautics and Space Administration, Washington, D.C.
CONTEMPORARY PROBLEMS IN AVIATION PHYSIOLOGY
N. P. Sergeyev, V. A. Sergeyev, and F. P. Kosmolinskiy *In its* Aviation and Space Med. Dec. 1964 p 379–384 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The nervous and emotional tension of flying has been shown to induce such physiological responses as shifts in the vegetative vascular reactions and in the mechanism of neuroendocrinal regulation, atherosclerosis, hypertonia, obesity, cardiovascular pathology, cholestrinemia, increased production of steroid hormones, and elimination of ascorbic acid. Because the increasingly complex equipment which the pilot must constantly monitor has overloaded the central nervous system and analyzers, particularly the visual analyzer, the work of the pilot is at the edge of the nervous system's physiological limits. Also unfavorable are the dynamic factors of flight and its unusual hygienic conditions. Aviation physiology must organize research to increase the flier's resistance to the damaging effects of flying, using engineering, psychological, and physiological means. Training, scheduling, special equipment, and new nutritional products are among the methods mentioned to meet the severe conditions of flight. R.L.K.

N65-13760* National Aeronautics and Space Administration, Washington, D.C.
THE ROLE OF REDUCED REACTIVITY OF THE ORGANISM IN RESISTANCE TO EXTREME INFLUENCES (ACCELERATION, RADIATION)
N. N. Sirotinin *In its* Aviation and Space Med. Dec. 1964 p 384–386 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Investigations of reactivity reduction due to various causes show that animals best tolerate acceleration during deep winter hibernation. Deep hypothermia is next most effective, followed by narcosis. Deep winter hibernation increases radiation resistance more than does hypothermia. R.L.K.

N65-13761* National Aeronautics and Space Administration, Washington, D.C.
SOME NEW INDEXES OF HEMODYNAMICS, OBTAINED BY MEANS OF THE MECHANOCARDIOGRAPHIC METHOD
M. N. Syviritkin *In its* Aviation and Space Med. Dec. 1964 p 386–387 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The mechanocardiographic method permits evaluation of the volume speed of blood outflow from the left ventricle into the aorta and of the power of contractions of the left ventricle. Simultaneous registration of tacho-oscillograms and sphygmograms permits determination of such hemodynamic indices as arterial pressure, systolic and minute volume of circulating blood, time of expulsion, speed of propagation of pulse wave along the vessels, and peripheral resistance. From the value of the systolic volume (CV in cm^3) and the expulsion time (t in seconds), the volume speed of blood expulsion in the aorta can be calculated. The VSO represents the quotient from the division of CV by t: VSO = CV/t cm^3/sec. The rate of the values of VSO and average hemodynamic pressure (My) permits calculation of the strength of the contractions of the left ventricle (P), as follows: $P = A/t = CV/t \cdot My = VSO \cdot My$ watt, where A is work performed during a unit of time. Average rates for these items in 300 healthy individuals were P = 2.64 to 2.65 watts and VSO = 253 cm^3/sec. In patients with neurocirculatory dystonia of the hypertensive type, the two indices were higher. R.L.K.

N65-13762* National Aeronautics and Space Administration, Washington, D.C.
METABOLIC CHANGES UNDER THE EFFECT OF PARACHUTE JUMPING
Yu. K. Syzrantsev, Yu. F. Udalov, and N. A. Chelnokova *In its* Aviation and Space Med. Dec. 1964 p 387–390 (See N64-13626 04-04) OTS: HC $7.63/MF $2.25

Urea elimination on parachute jumping days did not increase, so it was assumed that increased decomposition of nucleic acid did not take place. However, the blood nucleic acid content dropped to 280 mg percent as compared with 360 mg percent on control days. The changes in protein metabolism during jump training were similar to those shown under conditions of prolonged flight. The indices of vitamin metabolism dropped, indicating not only an increased vitamin requirement but also a marked emotional tension on jumping days. The greatest changes were found in vitamin B_1 metabolism, the vitamin which participates directly in transmittal of nervous stimulation, and in nicotinic acid exchange, which is closely associated with CNS function. Increased blood cholesterol was observed not only on the day of jumping but also on the following day; this, especially against a background of altered vascular tonus, is considered a forerunner of atherosclerosis.
R.L.K.

N65-13763* National Aeronautics and Space Administration, Washington, D.C.
VITAMINS IN THE DIET OF AVIATORS AND ASTRONAUTS
Yu. F. Udalov *In its* Aviation and Space Med. Dec. 1964 p 390–393 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Examination of a large number of flight personnel contradicts the supposition that vitamin requirements are based mainly on the level of energy expenditure. Vitamin consumption increased during exposure to vibration, prolonged acceleration, increased ambient temperature, weightlessness, high altitudes, extreme climates, and during testing of emergency lifesaving gear, and also in test pilots compared to regular pilots—in short, during any state of physiological stress. Vitamin-enriched diets for flying personnel not only prevent deficiencies but increase the body's resistance to unfavorable environmental factors, infections, etc., and result in increased work capacity and reduction of fatigue. It also has a normalizing effect on several metabolic indices affected by flight, especially the lipoid metabolism and the cholesterol blood levels.
R.L.K.

N65-13764* National Aeronautics and Space Administration, Washington, D.C.
CHANGES IN EXCITABILITY AND LABILITY OF THE VISUAL ANALYZER UNDER CONDITIONS OF PROLONGED NONSTOP FLIGHTS IN MULTIPASSENGER TURBOPROP PLANES
A. I. Ustinova *In its* Aviation and Space Med. Dec. 1964 p 393–395 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Flight crews were tested during and after 8- to 9-hour flights. During the first 3 to 4 hours of flight most crew members showed increased excitability and lability of the visual analyzer or maintained their takeoff level. In the 8th to 9th hour of flight there were fatigue-caused reductions in these indices in 77% of the cases observed. A 24- to 27-hour postflight rest period restored the visual analyzer functions to the initial level in the majority of subjects, but the instability of the restoration was shown on the return flight by a less clearly expressed positive phase and a greater degree of deterioration at all stages of the flight. Negative shifts were more pronounced in flight commanders than in other crew members, and on night flights than on daylight flights.
R.L.K.

N65-13765* National Aeronautics and Space Administration, Washington, D.C.
SOME METABOLIC INDEXES IN THE ASTRONAUTS YU. A. GAGARIN, G. S. TITOV, A. G. NIKOLAYEV AND P. R. POPOVICH
T. A. Fedorova, L. T. Tutochkina, M. S. Uspenskaya, M. M. Skurikhina, and Ye. A. Fedorov *In its* Aviation and Space Med. Dec. 1964 p 395–398 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Examination of astronauts by a special combination of analyses, before and after flight on spacecraft, provided definite data on biochemical changes occurring under such conditions. Biochemical tests were chosen which show significant deviations from the norm in "stress" states and under the effects of ionizing radiation. The study of several radiation-sensitive biochemical indices was of interest, inasmuch as it may be possible, during future prolonged flights traversing zones of dangerous radioactivity, to differentiate the bodily changes caused by radiation from those caused by other space-flight factors.
Author

N65-13766* National Aeronautics and Space Administration, Washington, D.C.
EFFECT OF ANGULAR ROTATION VELOCITIES ON THE STATE OF SEVERAL VISUAL FUNCTIONS
A. B. Flekkel' *In its* Aviation and Space Med. Dec. 1964 p 398–400 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Data obtained from rotation of subjects in a sitting position revealed the dependence of the visual functional state on the angular velocity of rotation and the degree of inclination of the subject's trunk from the vertical axis. With increased postural inclination, equivalent effects on the visual functions occurred at correspondingly smaller angular velocities. This was true of the several visual functions tested: visual acuity, critical flicker fusion frequency, and field of vision. During rotation in a supine position, the important determinant was the position of the axis of rotation in relation to the body of the subject. The effect on the visual functions was considerably greater when the axis of rotation passed through the vicinity of the head and the feet, and smaller when it passed through the vicinity of the heart. Maximum impairment of visual function occurred in the 5th to 6th minutes of rotation, after which the function was gradually restored. Analysis of the results indicates that the amount of change in visual function depends to a considerable degree on the magnitude of acceleration produced in the most distant part of the body.
R.L.K.

N65-13767* National Aeronautics and Space Administration, Washington, D.C.
REACTIVITY OF THE ORGANISM AND METHODS OF INCREASING ITS RESISTANCE TO CERTAIN FLIGHT FACTORS
I. M. Khazen *In its* Aviation and Space Med. Dec. 1964 p 401–406 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Summarized are experimental findings on the resistance of animals to hypoxia, acceleration, rolling motion, explosive decompression, microwaves, and X-rays. Also studied are the characteristics of the adaptation reactions of man to these factors. Correlations between the various functional systems under the influence of a given stimulus were noted and criteria obtained for judging the reactivity of the organism. Particular attention was paid to oxygen deficiency since hypoxic conditions, judged from tissue processes, may also occur after exposure to several other stimuli. Thus, tissue adaptation to hypoxia is of significance in solving problems connected with increasing resistance to acceleration, explosive

decompression, radiation, etc. In addition to the general clinico-physiological methods, the neuroglandular apparatus of the digestive system was used as an indicator in studying general homeostatic reactions. In prophylactic intervention, microwaves were used to increase resistance to hypoxia, and physical training was used as a general means of increasing resistance to flight factors. R.L.K.

N65-13768* National Aeronautics and Space Administration, Washington, D.C.

HISTOPHYSIOLOGICAL CHANGES IN ANIMALS EXPOSED TO ACCELERATIONS

I. M. Khazen, E. M. Kogan, and A. S. Barer *In its* Aviation and Space Med. Dec. 1964 p 406–409 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The effects of repeated exposures to acceleration upon the morphology of organs and tissues was investigated in rats. Histological investigation of tissues obtained from the brain, heart, lungs, liver, and kidneys immediately after acceleration showed a pattern of increase in the morphological changes in various tissues and lungs of animals in relation to the frequency of exposure. A definite relationship was noted between the morphological changes and duration of action after eight exposures to accelerations of lesser intensity but greater duration. In all variations of the experiments, the reaction of the cardiovascular system was most pronounced. R.L.K.

N65-13769* National Aeronautics and Space Administration, Washington, D.C.

THE EFFECT OF ADEQUATE STIMULATIONS OF THE VESTIBULAR APPARATUS ON THE ELECTRICAL POTENTIAL OF THE STOMACH

V. T. Khlebas and N. P. Kozhukhar' *In its* Aviation and Space Med. Dec. 1964 p 410–413 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Electrogastrography was used to study the digestive function of dogs under conditions of cosmic flight. Strong, prolonged stimulation of the vestibular apparatus caused changes in the bioelectric potential of the stomach. In the majority of the cases the potential was lowered. An analysis of the results showed that lowering of the stomach potential coincided with the excitation of the gastric glands. Motion-induced sickness was a stronger stimulator of the gastric glands than was rotation. The individual dogs did not exhibit identical secretory–motor reactions of the stomach when the vestibular apparatus was stimulated. R.L.K.

N65-13770* National Aeronautics and Space Administration, Washington, D.C.

THE STATUS OF ANTICOAGULATING MECHANISMS UNDER CONDITIONS OF PROLONGED HYPOKINESES

Ye. I. Chazov and V. G. Ananchenko *In its* Aviation and Space Med. Dec. 1964 p 414–415 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

To judge the effect of hypokinesis on anticoagulation capacities of the organism, researchers studied the content of free heparin in the blood, the fibrinolytic activity of the blood, the plasma heparin tolerance, and thromboelasticity. In the first series, studies were carried out before and after a 3-day period under hypokinesic conditions. Three of the four subjects did not show any regularity in changes of state of the thrombus-forming properties of the blood. More regular changes were obtained in the second series of investigations with prolonged hypokinesic states, when four subjects were in a state of prolonged rest for a period of 20 days. It was found that prolonged hypokinesis in healthy persons leads to an increase in the anticoagulating and lytic properties of the blood, which lessens the possibilities for thrombus formation. In the third series, four subjects also remained on a prolonged bedrest regime, but systematically carried out a complex of definite physical exercises. No increase was noticed in the fibrinolytic activity of the blood and in the content of free heparin. R.L.K.

N65-13771* National Aeronautics and Space Administration, Washington, D.C.

THE EFFICACY OF THE PHARMACOLOGICAL PREPARATION NII IN COMBATING MOTION SICKNESS OF AIR TRANSPORT PASSENGERS

A. V. Chapek *In its* Aviation and Space Med. Dec. 1964 p 416–419 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The therapeutic preparation NII, which contains camphorated scopolamine, hyoscyamine, and nicotinic acid, exhibits a stimulating action on the central nervous system and lowers the excitability of its parasympathetic section. The nicotinic acid, which is part of the tablet, has a positive action on disorders of the internal organs (heart, liver) and on ulcers. It exhibits a vasodilating action (M. D. Mashkovskiy). Side effects of the tablet are dryness in the mouth and reddened countenance. After ingestion, these effects go away automatically. The efficacy of the therapeutic agent, tablet NII, was confirmed under laboratory conditions with experimental motion sickness and in flight. In flight, we carried out two series of experiments: in one experiment, passengers who were subject to motion sickness were given NII tablets; in the other experiment, aeron, which consists of comphorated scopolamine and camphorated hyoscyamine, was given as a control. The NII tablets and aeron were given for prophylaxis and therapy of motion sickness. Author

N65-13773* National Aeronautics and Space Administration, Washington, D.C.

SOME MICROORGANISMS AS INDICATORS OF SOLAR ACTIVITY AND PRECURSORS OF SOLAR FLARES

A. L. Chizhevskiy *In its* Aviation and Space Med. Dec. 1964 p 422–423 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

It appears that nerve cells and certain microorganisms are highly sensitive to solar activity, and, by their reactions, at the atomic–molecular level, signal nuclear processes taking place inside the sun 4 to 5 days earlier than astrophysical instruments indicate any changes in the surface layers of the sun. Study of daily or 10-day curves of epidemic outbreaks showed that, in some instances, sharp peaks in the epidemics forecast astrophysical phenomena. This early warning was quite accurate in the case of mortality from infections and cardiovascular diseases. Similar results were produced in the laboratory. These investigations were carried out in the years between 1915 and World War II. R.L.K.

N65-13774* National Aeronautics and Space Administration, Washington, D.C.

SIGNIFICANCE OF PARASYMPATHETIC NERVOUS SYSTEM TONE IN INCREASING RESISTANCE TO FLIGHT FACTORS

M. D. Chirkin *In its* Aviation and Space Med. Dec. 1964 p 424–427 ref (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The tone of the vagus nerve center was investigated in a comparative physiological manner, with frogs, dogs, and humans as the subjects. The results, supported by others reported in the literature, show that, in general, the higher an animal is on the phylogenetic ladder, and, therefore, the stronger the tone of its vagus nerves, the greater the resistance to unfavorable and unusual environmental agents. Intensified parasympathetic tone also resulted from physical exercises which increased endurance. Correlations between parasympathetic nerve tone and motion sickness are discussed. R.L.K.

N65-13775* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF BRIEF PHYSICAL TRAINING ON THE SURVIVAL OF WHITE RATS KEPT UNDER CONDITIONS OF PROLONGED HYPODYNAMIA AND ISOLATION

V. A. Shkurdoda *In its* Aviation and Space Med. Dec. 1964 p 427–429 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Investigations to determine the specific effect of systematic training on tolerance of hypodynamia and isolation, and to ascertain the degree of resistance to ionizing radiation in rats subjected to various motor regimes are reported. Analysis of the various indexes of motor and autonomic functions indicated that vigorous muscular activity rather than passive rest (transfer of rats from small cages to larger ones) was required to maintain resistance under conditions of hypodynamia and isolation. Physical training probably helped to insure the equilibrium and mobility of the nervous processes, a factor in resistance to hypodynamia and X-irradiation. During hypodynamia, only 6% of the animals given brief training died as compared with 41% of the untrained animals. The rats most resistant to irradiation after hypodynamia were also the animals given brief active training. Two- to three-times more trained animals survived than untrained animals. Passive rest during hypodynamia and isolation improved the survival rate, but lowered the resistance to X-irradiation. R.L.K.

N65-13777* National Aeronautics and Space Administration, Washington, D.C.

PHYSIOLOGICAL REACTIONS IN WEIGHTLESSNESS

Ye. M. Yuganov *In its* Aviation and Space Med. Dec. 1964 p 431–434 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The effect of brief weightlessness on animals and man was examined experimentally to determine the nature and intensity of changes in the vestibular, motor, and tactile analyzers, of impairment of functional interrelations, and of changes in muscle tone and in cardiovascular and respiratory activity. Results indicate that the excitability of the semicircular canals decreases during weightlessness, and the nature of the changes observed indicates that this decrease is due to inhibition of the semicircular canals by impulses from the otoliths, whose influence is much greater during weightlessness. The summation of these stimuli activates the cortical and subcortical regions, producing the symptoms of space sickness. Reflexes from the vestibular analyzers are also important in changes in muscular tone and venous circulation that may affect human efficiency in weightlessness. R.L.K.

N65-13778* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF AIRPLANE NOISE ON MAN AND NOISE CONTROL MEASURES

Ye. M. Yuganov, I. Ya. Borshchevskiy, Yu. V. Krylov, and V. S. Kuznetsov *In its* Aviation and Space Med. Dec. 1964 p 434–436 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Noise can cause fatigue, and hearing, visual, respiratory rate, cardiac activity, and blood pressure impairment. It changes the size of the spleen and kidneys, reduces the number and amplitude of gastric contractions and increases gas exchange. After prolonged exposure to noise, people develop insomnia, timidity, slowing of mental reactions, and inattentiveness. The situation at jet engine test stations is most in need of control. The installation of special sound-absorbing equipment is suggested, as well as the use of individual devices. Work routines should include short rest periods in soundproof places. R.L.K.

N65-13780* National Aeronautics and Space Administration, Washington, D.C.

SENSORIMOTOR COORDINATION IN EXTENDED WEIGHTLESSNESS IN ACTUAL SPACE FLIGHT

V. I. Yazdovskiy, I. I. Bryanov, L. I. Kakurin, Yu. V. Krylov, and M. A. Cherepakhin *In its* Aviation and Space Med. Dec. 1964 p 439–441 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The flight programs of Vostok 3 and Vostok 4 included a study of the effect of extended weightlessness on sensorimotor coordination in astronauts Nikolayev and Popovich. Special tests were conducted in the laboratory, under simulated space-flight conditions, and during the flights themselves to reveal coordination, handling of spacecraft equipment, and handwriting of the astronauts. Weightlessness did not appear to impair sensorimotor coordination. R.L.K.

N65-13781* National Aeronautics and Space Administration, Washington, D.C.

RADIATION REACTIONS AND CHEMICAL PROTECTION OF ANIMALS EXPOSED TO HIGH-ENERGY PROTONS

S. P. Yarmonenko, E. B. Kurlyandskaya, G. A. Avrunina, Ye. S. Gaydova, R. D. Govorun et al *In its* Aviation and Space Med. Dec. 1964 p 442–445 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Results are presented of comparative experiments on mice receiving whole-body radiation from protons and from γ-rays of Co^{60}. The relative biological effectiveness of the protons on hematopoiesis, on reproductive function, and on somatic mutations was consistently lower than that of γ-rays. The effectiveness of chemical protection by preliminary injection with S,β-aminoethylisothiuronium, mercaptoethylamine, and 5-methoxytryptamine is discussed. Further information was obtained on the effect of protons on blood protein fractions, and the long-range blastomutagenic effects. R.L.K.

N65-13804# Liège U. (Belgium).

RESEARCHES PERFORMED ON THE EFFECTS OF CERTAIN CHEMICAL RADIOPROTECTORS, YEARS 1962–1963 [RECHERCHES SUR LES EFFETS MULTIPLES DE CERTAINS RADIOPROTECTEURS CHIMIQUES, ANNEES 1962–1963]

Brussels, EURATOM, Aug. 1964 14 p In FRENCH; ENGLISH summary

(Contract EURATOM-006-61-12 BIOB)

(EUR-1835.f) Available from Belgian Am. Bank and Trust Co., Account No. 22.186: 40 Belg. Fr.

The research includes the following: biochemical, pharmacological, and cytological effects of cysteamine and its main metabolites and of cystamine on various animal systems (for instance, mouse ascites tumor, isolated frog heart, mouse

hair, chicken embryo, cat nictating membrane); (2) effects of cysteamine on different enzymatic systems in vitro, on bile components, and on hepatic mitochondria; and (3) effects of various radioprotectors on microorganisms (*E. coli*) and on plants (cytoplasmic stream of *Nitella*, growth of barley seedlings). Author

N65-13827*# National Aeronautics and Space Administration, Washington, D.C.

EXPERIMENTAL INVESTIGATIONS ON ULTRA-LOW FREQUENCY DISPLACEMENT BALLISTOCARDIOGRAPHY [EXPERIMENTELE ONDERZOEKINGEN OVER DE ULTRA-LAAGFREQUENTE VERPLAATSINGSBALLISTO-CARDIOGRAFIE]

Antonius Adrianus Knoop (Ph.D. Thesis—Amsterdam U., 1962) Jan. 1965 112 p refs Transl. into ENGLISH from DUTCH (NASA-TT-F-269) OTS: HC $4.00/MF $0.75

The historical development of ballistocardiography is traced, nomenclature for ballistocardiographic methods is given, and the calibration of apparatus is described. The ballistocardiogram of man is discussed in relation to methods for determining the stroke volume and for recording the ballistocardiogram, the blood pressure, and the electrokymogram. The ballistocardiogram of the dog is described, the influence of the recording-axis direction on the graph is discussed, and some aspects of the genesis of the ballistocardiogram of the dog are presented. Effects of aortic occlusion, vasodilator drugs, norepinephrine, pitressin, and respiratory arrest on ballistocardiograms are discussed. D.E.W.

N65-13829*# National Aeronautics and Space Administration, Washington, D.C.

AEROSPACE MEDICINE AND BIOLOGY—A CONTINUING BIBLIOGRAPHY

Dec. 1964 151 p refs

(NASA-SP-7011(05)) OTS: HC $1.00/MF $1.00

Abstracts are included that refer to the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on lower organisms are also covered. Attention is given to such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors. R.L.K.

N65-13845# Argonne Cancer Research Hospital, Chicago, Ill.

THE CONSEQUENCES OF INGESTION BY MAN OF REAL AND SIMULATED FALLOUT

George V. Le Roy, John H. Rust, and Robert J. Hasterlik [1963] 36 p refs

(Contracts AT-(11-1)-69; OCD-OS-62-214)

(ACRH-102)

Real and simulated particulate fallout and solutions of $Sr^{85}Cl_2$ and $Cs^{134}Cl_2$ were fed to 102 healthy volunteers. Absorption and retention of ingested radioactivity was measured by whole-body counting, using a gamma-ray spectrometer. An average of 3% of the radioactivity of week-old local fallout was absorbed; the range was 0% to 9%. Strontium and cesium leached or dissolved from simulated fallout behaved in the same way, metabolically, after absorption as they did when the tracer was swallowed in a solution or injected intravenously. The large number of subjects studied provided additional information of the range of variation of intestinal motility, biological availability of strontium, cesium and barium following ingestion of fallout, and retention of the radionuclides of these elements. Author

N65-13861*# General Technical Services, Inc., Cleveland, Ohio.

GENERAL DYNAMICS OF PHYSICAL CHEMICAL SYSTEMS IN MAMMALS First Quarterly Progress Report, 1 Jun.–20 Nov. 1964

A. S. Iberall 7 Dec. 1964 5 p

(Contract NASw-1066)

(NASA-CR-59990) OTS: HC $1.00/MF $0.50

A dynamic oscillator instrument concept for medical diagnosis is being developed based on the spectral analysis of cyclic phenomena of mammals. It has been modeled from a spectrum of sustained limit cycle oscillations evident from studies of human thermoregulation, cardiovascular, hormonal, and behavioral systems. In the appended abstract of the human thermoregulation study, the 100-sec cycle is considered as the basic engine cycle and the vehicle for heat production; its regulation arises primarily in the skeletal muscles from unstable units. The 400-sec cycle is a hormonally mediated cycle arising from the hypothalamus and regulating the overall blood flow. Since the peripheral circulation is the major vehicle for surface temperature regulation and heat dissipation control, it is concluded that the 400 sec blood flow cycle is the major thermoregulator. G.G.

N65-13863# Joint Publications Research Service, Washington, D.C.

CHANGES IN THE NERVOUS SYSTEM – IN VERTIGO AND AFTER TERMINAL CONDITIONS

7 Jan. 1965 27 p refs Transl. into ENGLISH from Klinicheskaya Meditsina (Moscow), v. 42, no. 9, Sep. 1964 (JPRS-28177; TT-65-30081) OTS: $2.00

Overloading of the vestibular analyzer induces an illusion of movement of the body or surrounding objects (dizziness) and impairment of maintaining equilibrium. Vertigo associated with pathological changes in the peripheral part of the vestibular analyzer is discussed. Vestibular disorders, including vertigo, may be observed in lesions of various parts of the nervous system. Meniere's disease is the most frequent cause of vertigo. Changes of the nervous system in patients who have sustained terminal states were observed, and an attempt was made to elucidate the properties of neurological disturbances, and their nature and extent in various stages of terminal states. E.C.

N65-13994# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

CARDIOPULMONARY MEASUREMENTS OBTAINED BY RIGHT AND LEFT CARDIAC CATHETERIZATION OF MACACA MULATTA

Ralph O. Hayden Oct. 1964 11 p refs

(AMRL-TDR-64-69; AD-608790)

Eight normal *Macaca mulatta* anesthetized with pentobarbital were subjected to right and retrograde left heart catheterization and to analysis of expired gas. Measurements were made of the aortic, left ventricular, pulmonary capillary, pulmonary arterial, right ventricular and right atrial pressures, heart rate, cardiac and stroke index, peripheral and pulmonary vascular resistance, tension–time index, systolic ejection period and rate index, left ventricular work and stroke index, minute respiratory volume and oxygen consumption index, and arterial and mixed venous blood oxygen content and saturation. The data will serve as a baseline for cardiopulmonary studies with this species. Author

N65-14004# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
PYRIDOXINE (VITAMIN B_6) TOXICITY Literature Review, 1940–June 1963
Robert A. Schneider Oct. 1964 17 p refs
(AMRL-TR-64-106; AD-608841)

The literature from 1940 through June 1963 was surveyed to summarize the data from pyridoxine toxicity studies in animals and to ascertain the highest doses of pyridoxine (Vitamin B_6 analogs) that have been administered to human subjects as a therapeutic measure with no clinical evidence of toxicity. Analysis of the data indicated that doses of 25 mg/kg pyridoxine hydrochloride should be well tolerated as a therapeutic measure when required. In particular, pyridoxine hydrochloride can be used in the specific treatment of a clinical entity such as acute UDMH intoxication. Author

N65-14007# Zaret Foundation, Inc., Scarsdale, N.Y.
AN EXPERIMENTAL STUDY OF THE CATARACTOGENIC EFFECTS OF MICROWAVE RADIATION Final Report, 8 May 1963–7 May 1964
Milton M. Zaret et al Griffiss AFB, N.Y., RADC, Oct. 1964 27 p refs Prepared in cooperation with New York U. and Polytechnic Inst. of Brooklyn
(Contract AF 30(602)-3087)
(RADC-TDR-64-273; AD-608746)

An exploratory investigation was performed to determine the applicability of spectrophotometric analysis to the measurement of cataractogenesis. It was found that standard spectrophotometric techniques cannot be utilized for this purpose, but that a new method for performing spectrophotometry in the living eye, which is known as retinal reflection densitometry, shows promise of being capable of performing this task. A methodology is presented for an applied research investigation of cataractogenesis in order to delineate the parameters of personnel hazard associated with microwave environments. The biological and microwave experimental protocols, as well as the relationship of laboratory-induced cataractogenesis to the clinical study of human microwave cataracts are discussed. Author

N65-14026# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SUPERSONIC AIR COMMERCE—PROBLEMS AND PROJECTS
Jochen Grenzdoerfer 9 Sep. 1964 27 p Transl. into ENGLISH from Aerosport (Germany), no. 1, 1964 p 1–11
(FTD-TT-64-463/1+2; AD-450605)

Capitalist and socialist approaches to the construction and use of supersonic transports are compared. The U.S. and British–French models are evaluated. The safety record of jet airlines in capitalist countries is cited. The sound and heat barriers are discussed. The operational profile for a Mach 3 airliner suggests passing through the sound barrier at an altitude of about 13 km. A fuselage composed of aluminum and titanium alloys is suggested as suitable for the Concorde, as is pure steel for the American Mach 3 SST. Other problems mentioned are cabin pressurization, cosmic radiation, flight safety, and fuel consumption. R.L.K.

N65-14157# Joint Publications Research Service, Washington, D.C.
MEDICAL PROBLEMS IN SPACE TRAVEL
Mikhail Novikov 5 Jan. 1965 7 p refs Transl. into ENGLISH from Trud (Moscow), 15 Oct. 1964 p 2
(JPRS-28113; TT-65-30042) OTS: $1.00

Aeromedicine is considered as the basis of cosmic medicine. Specialists in cosmic medicine have a variety of duties and observations to perform. They take part in the selection of astronauts, accompany them on the space trip, and check the crew out after landing. Space physicians must be able to utilize supersensitive electronic devices to discover and prevent the slightest variations in the astronaut's condition; they also have to consider the biological compatibility of the crew members and their ecological environment during the space flight. The physician participates in plotting the cosmic routes, in selecting the system of a manned rocket, and in the design and creation of the spaceship. G.G.

N65-14164# Joint Publications Research Service, Washington, D.C.
PRINCIPLES OF MOLECULAR BIOLOGY: GENETICS AND SELECTION OF MICROORGANISMS
7 Jan. 1965 52 p refs Transl. into ENGLISH of two chapters from the book "Osnovy Molexularnoy Biologii: Genetika i Selektsiya Mikroorganizmov" Moscow, 1964 p 31–60, 151–164
(JPRS-28187; TT-65-30091) OTS: $3.00

In *"Molecular Mechanisms of Chemical Mutagenesis in the Bacteriophage*, the interaction of mutagens with DNA is discussed. The effects of base analog and acridine mutagens on the synthesis of DNA, the induction of direct mutations, and mutation frequency due to nitrogen base analogs are also reviewed. Enzyme synthesis and genetic regulation due to induction, repression, and retroinhibition are discussed in *Genetic Mechanisms of the Regulation of Protein Biosynthesis in Microorganisms*. The connection between protein structure and its biological activity is also investigated. M.G.J.

N65-14173# European Organization for Nuclear Research, Geneva (Switzerland). Health Physics Group
RADIOBIOLOGICAL PROBLEMS IN PROTECTION, PREVENTION AND THERAPY OF HIGH-ENERGY RADIATION INJURY
Antonio Pasinetti 1 Apr. 1964 55 p refs
(DI/HP/39)

Protective measures, prevention, and therapy of radiobiological injuries are considered in the following studies: *Some of the Biophysical and Biological Aspects of Ionizing Radiation*—the interaction between ionizing radiation and living matter, and the biological response to ionizing radiation; *Irradiation of Man; Pharmacological Protection; The Biological Aspects of High-Energy Radiation; Significance of the Maximum Permissible Doses: Their Value and Their Limitations; Steps to be Taken in the Event of Accidental Irradiation, and Emergency Measures;* and *Measures to Improve Safety Conditions*. G.G.

N65-14326# Agricultural Research Service, Riverside, Calif. Salinity Lab.
WATER TRANSFER FROM SOIL TO THE ATMOSPHERE AS RELATED TO SOIL PROPERTIES, PLANT CHARACTERISTICS AND WEATHER Annual Report, 1 Jul. 1963–30 Jun. 1964
W. R. Gardner, E. J. Doering, C. F. Ehlig, F. J. Miklich, and L. A. Richards Jul. 1964 98 p refs
(RR-374; AD-421425)

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2. MOVEMENT OF SOIL WATER W. R. Gardner, L. A. Richards, F. J. Miklich, and E. J. Doering 13 p refs
3. SOIL-WATER ENERGY RELATIONS L. A. Richards 1 p

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4. SOIL-WATER DIFFUSIVITY BY THE ONE-STEP METHOD E. J. Doering 14 p refs
5. METALLIC CONDUCTION FOR COOLING A THERMOCOUPLE PSYCHROMETER BATH L. A. Richards 14 p refs

N65-14413# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering

AN INVESTIGATION OF THE APPLICATION OF SPATIAL VECTORELECTROCARDIOGRAPHY TO PROBLEMS OF CENTRAL CARDIOVASCULAR SYSTEM CONSTRAINT

David Clifford Westhorp (M.S. Thesis) Aug. 1964 58 p refs (GE/EE/64-23; AD-607534) OTS: $3.00

Methods to determine heart position under conditions of vibration by using vectorelectrocardiographic techniques were investigated. An experiment to validate a theory is described, based on conductivity inhomogeneities of tissues surrounding the heart and proposing amplitude modulation of electrocardiographic wave form frequency components under conditions of sinusoidal vibration. Results are presented which show that frequency analysis of the wave form does not yield the desired displacement information due to lack of physiological standardization. A proposed method of extending Ernest Frank's mirror image cancellation method to vibration problems by using time sampling and computer data reduction is presented. Author

N65-14420# Texas Christian U., Fort Worth. Inst. of Behavioral Research

DIMENSIONS OF STIMULUS SITUATIONS WHICH ACCOUNT FOR BEHAVIOR VARIANCE Annual Progress Report

S. B. Sells 1 Oct. 1964 6 p refs (Contract Nonr-3436(00)) (AD-607810)

The following summary of work accomplished and in progress is organized under four headings: (1) taxonomic analysis of situational variables; (2) analysis of group dimensions; (3) influence of meteorological variables on behavior; and (4) bibliographic review of behavioral ecology. Author

N65-14436# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering

COUNTERROLLING OF THE HUMAN EYE

Richard J. Flaherty and Gary K. Pritchard (M.S. Thesis) Aug. 1964 108 p refs (GE-EE-64-8; AD-607482)

Counterrolling is a conjugate rolling movement of the eye around the line of sight opposite to the lateral inclination of the head. Measurements of counterrolling were obtained for four subjects (three normal and one labyrinthine defective) for static positions of lateral head (body) tilt and for vertical rotation in the frontal plane at constant rates up to 30 rpm. A specially designed rotating chair and cine photographic technique were used. The measured static counterrolling responses compared favorably with those obtained by other investigators. The dynamic counterrolling responses were similar to the static responses except for a constant time lag of 1/3 second and a decrease in amplitude. Author

N65-14451*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

GASEOUS ENVIRONMENT CONSIDERATIONS AND EVALUATION PROGRAMS LEADING TO SPACECRAFT ATMOSPHERE SELECTION

Edward L. Michel, George B. Smith, Jr., and Richard S. Johnston Washington, NASA, Jan. 1965 401 p refs (NASA-TN-D-2506) OTS: HC $8.50/MF $2.00

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6. THE EFFECT OF SEQUENTIAL EXPOSURE TO ACCELERATION AND THE GASEOUS ENVIRONMENT OF THE SPACE CAPSULE UPON THE PHYSIOLOGIC ADAPTION OF MAN R. E. Mammen, G. T. Critz, D. W. Dery, F. M. Highly, Jr., and E. Hendler (Naval Air Mater. Center) p 475–518 refs (See N65-14457 04-04)

N65-14452* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

RAPID DECOMPRESSION HAZARDS AFTER PROLONGED EXPOSURE TO 50% OXYGEN–50% NITROGEN ATMOSPHERE

Morris J. Damato, Francis M. Highly, Edwin Hendler, and Edward L. Michel *In its* Gaseous Environment Considerations and Evaluation Programs Leading to Spacecraft Atmosphere Selection Jan. 1965 p 7–24 refs (See N65-14451 04-04) OTS: HC $8.50/MF $2.00

In studying the rapid decompression hazard following exposure to a proposed space capsule atmosphere, tests were conducted with subjects breathing a 50% oxygen–50% nitrogen mixture for various durations at a simulated altitude of

18 000 feet prior to rapid decompression to a simulated altitude of 35 000 feet. It was found that: (1) during repeated exposures, recurrence of bends in the same area is very likely; (2) the manifestation of bends may be delayed for more than 2 hours following decompression; and (3) characteristic sensations of bends may be either localized in one area or may radiate eventually to involve more than one area simultaneously. Procedures which, when applied prior to decompression, minimize the incidence of bends are outlined. P.V.E.

N65-14453* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PHYSIOLOGIC EFFECTS OF EXPOSURE TO INCREASED OXYGEN TENSION AT 5 psia
Thomas E. Morgan, Jr., Ralph G. Cutler, Emil G. Shaw, Frode Ulvedal, John L. Hargreaves et al *In its* Gaseous Environment Considerations and Evaluation Programs Leading to Spacecraft Atmosphere Selection Jan. 1965 p 25–56 refs (See N65-14451 04-04) OTS: HC $8.50/MF $2.00

The effects of prolonged (14-day) exposure to a total pressure of 258 mm Hg and a P_{O_2} of 242 mm Hg were studied in 4 men. No distinct evidence of atelectasis was noted based on the following data: arterial P_{O_2}, alveolar P_{O_2}, estimated A-V shunt, chest X-ray, vital capacity, and performance. No hematological disorders were noted that were directly attributable to the oxygen-rich environment. One subject did develop a self-limiting anemia of nonspecific origin and possibly complicated by repeated blood samples during the course of the experiment. Symptoms similar to those of oxygen toxicity were encountered in all subjects. The data obtained indicate that this atmosphere (242 mm Hg P_{O_2}) can be well tolerated for a 14-day period. Exposure for time periods much in excess of this duration should be approached with a certain degree of caution. Author

N65-14454* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EFFECT OF VENTILATING AIR FLOW ON HUMAN WATER REQUIREMENTS
B. E. Welch, R. G. Cutler, J. E. Herlocher, J. J. Hargreaves, F. Ulvedal et al *In its* Gaseous Environment Considerations and Evaluation Programs Leading to Spacecraft Atmosphere Selection Jan. 1965 p 57–85 refs (See N65-14451 04-04) OTS: HC $8.50/MF $2.00

Experiments were conducted on two subjects wearing pressure suits in a spacecraft atmosphere of 5 psi and essentially 100% oxygen. Both men wore fitted, ventilated, full-pressure garments during a daily schedule consisting of two alternating 5-hour periods per man per day in the full suit, with the torso portion being worn the remainder of the time. Preliminary data indicated that the ventilated pressure garments had a marked, increasing effect on water requirements. The increase was influenced by suit inlet air temperature and by the environmental conditions surrounding the suit–man combination. Water requirements while wearing the suit continuously averaged 1196 cc/man/day with an inlet air temperature of 60.6° F. Heat loss from the body via evaporative cooling was greater than in a "shirt sleeve" environment but still did not assume a dominant role in maintaining thermal equilibrium. P.V.E.

N65-14455* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
BACTERIOLOGICAL STUDIES OF TWO-MAN SPACE CABIN SIMULATOR
James E. Moyer and Y. Z. Lewis *In its* Gaseous Environment Considerations and Evaluation Programs Leading to Spacecraft Atmosphere Selection Jan. 1965 p 86–99 refs (See N65-14451 04-04) OTS: HC $8.50/MF $2.00

Microbiological findings collected from three 14-day experiments conducted within the two-man space cabin simulator at the USAF School of Aerospace Medicine, Brooks AFB, indicated that no significant degree of microbic interchange occurred between individuals under conditions of close occupancy for the periods studied. Bacterial aerosol counts of the cabin atmosphere revealed no cumulative buildup of microorganisms with time. Water condensates from the heat exchangers connected to the full-pressure suits worn by the latter two individuals were subjected to quantitative and qualitative bacteriological analysis. Subsequent evaluation of stored-condensate samples revealed tremendous proliferation of the micro-organisms originally present. Author

N65-14456* Republic Aviation Corp., Farmingdale, N.Y.
EFFECTS OF PROLONGED EXPOSURE TO PURE OXYGEN ON HUMAN PERFORMANCE
William M. Helvey, G. A. Albright, F. B. Benjamin, L. S. Gall, J. M. Peters et al *In* NASA Manned Spacecraft Center, Houston, Tex. Gaseous Environment Considerations and Evaluation Programs Leading to Spacecraft Atmosphere Selection Jan. 1965 p 100–474 refs (See N65-14451 04-04) OTS: HC $8.50/MF $2.00
(Contract NASr-92)

The objective of this study was to determine if exposure to a pure oxygen environment, such as that currently used in the Project Mercury spacecraft, would have detrimental effects on the health or performance of astronauts. A broad approach to the problems associated with pure oxygen at various barometric pressures in the absence of an inert gas was planned. Four groups of six men each were selected to live in an altitude chamber for a 2-week period. Three of the groups lived in an oxygen environment at total pressures of 3.8, 5.0, or 7.4 psi, and a fourth group served as a control in a sea-level (14.7 psi) environment of air. Detailed medical, physiological, hematological, biochemical, microbiological, and psychological studies were conducted on all subjects. Author

N65-14457* Naval Air Engineering Center, Philadelphia, Pa. Air Crew Equipment Lab.
THE EFFECT OF SEQUENTIAL EXPOSURE TO ACCELERATION AND THE GASEOUS ENVIRONMENT OF THE SPACE CAPSULE UPON THE PHYSIOLOGIC ADAPTION OF MAN
Robert E. Mammen, George T. Critz, Donald W. Dery, Francis M. Highly, Jr., and Edwin Hendler *In* NASA Manned Spacecraft Center, Houston, Tex. Gaseous Environment Considerations and Evaluation Programs Leading to Spacecraft Atmosphere Selection Jan. 1965 p 475–518 refs (See N65-14451 04-04) OTS: HC $8.50/MF $2.00
(NAEC-ACEL-498)

The combined effects of acceleration and continuous exposure for 14 days to 100% oxygen at 258-mm Hg pressure on subjects representative of the astronaut population were investigated. No evidence of physiological alteration was detected during the study with the exception of temporary impairment of peripheral scotopic vision. Hematological changes were detected during the study. The average drop in hemoglobin and hematocrit was significantly different from pretest figures. There was no rise in bilirubin or in urinary urobilinogen, a slight rise in reticulocytes, a significant rise in neutrophils and platelets, and a tendency to hypochromia and microcytosis.

Electrocardiograms were uniformly normal, and dark adaptation showed a decrease in rate and final sensitivity at 17° nasal retinal field. No evidence was obtained to indicate that any physiological detriment of operational significance would be suffered by astronauts exposed to the test conditions. P.V.E.

N65-14470# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CZECHOSLOVAKIAN NEUROLOGY Selected Articles
3 Aug. 1964 36 p refs Transl. into ENGLISH from Cesk. Neurol. (Czechoslovakian), v. 26, no. 3, 1963 p 145–151, 169–173, 184–191
(FTD-TT-64-267/1+2; AD-450604)

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2. SIMPLE ANALYZER CARD FOR REGISTRATION OF EEG FINDINGS J. Klapetek p 14–21
3. EFFECT OF RADIATION ON HUMAN EEG E. Klimkova-Deutschova p 22–33 refs

N65-14471# California U., Berkeley. Electronics Research Lab.
REPORT ON EXPERIMENTS WITH THE OLFACTORY CORTEX OF THE CAT
G. G. Furman 17 Jan. 1964 43 p refs
(Grants AF-AFOSR-62-340; NIH B-2537; FFRP-G-59-203)
(Rept.-64-1; AD-430077)

Experiments with the stimulation of the olfactory cortex of the cat were conducted with the help of chronically implanted bipolar electrodes for recording and stimulation. The final response data were obtained by averaging 10 or more time responses so as to raise the signal-to-noise ratio. An analytic expression for the theoretical cortical response was obtained by means of a model which treats the primary cortical unit as a current generator of damped sinusoids. The theoretical curves, as generated by a digital computer, showed an excellent fit with some of the experimental curves. Some alternative theories are also discussed, because the present one was not shown to be a unique solution. Nevertheless, it was thought that because it utilizes a new technique of spatial summation in a neuronal tissue, it provides a realistic basis for the analysis of evoked cortical potentials. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-13509# Joint Publications Research Service, Washington, D.C.
PHILOSOPHICAL PROBLEMS IN SCIENCE
G. M. Dobrov et al 29 Dec. 1964 47 p refs Transl. into ENGLISH of 3 articles from Vopr. Filosofii (Moscow), no. 10, Oct. 1964 p 59–82, 151–157
(JPRS-28029; TT-65-30010) OTS: $2.00

On the Prognoses for the Development of Science, discusses the character of scientific development, the possibility of limits and scientific productiveness. *Modern Questions in the Organization and Localization of Brain Functions* deals with the organization of the brain function, the organization of the cortico-subcortical interaction, methods for studying the localization of brain functions, methods of representing the localization of brain functions, and the localization of higher psychic functions. A review is given of the book, *Totality and Development in Light of Cybernetics*. R.L.K.

N65-13512# Human Factors Research, Inc., Los Angeles, Calif.
A STUDY OF FACTORS INFLUENCING THE JUDGMENT OF HUMAN PERFORMANCE. IRRELEVANT FACTORS IN THE JUDGMENT OF HUMAN PERFORMANCE
Frank L. Herbert, H. D. Kimmel, and James J. Mc Grath Sep. 1964 21 p refs
(Contract Nonr-4140(00))
(TR-4; AD-607079) OTS: $1.00

The effect of the order of judging the performance of different individuals on the judgments themselves was studied. The performance tasks are described, and the observation conditions for the people judging the performance are given. Results showed that, even when performances were objectively equated and the order of their being judged was controlled by complete counterbalancing, significant differences were present among the average ratings given to the three operators. There was no difference in the average ratings due to ordinal position in which the operator was judged. The most important implication of these results is considered to be that subjects tend to judge performances as different even when they do not differ objectively and even when other factors, such as the order in which they are judged, are controlled. The possibility is considered that the judges' task in this situation induced a set of "find" differences when there were none. D.E.W.

N65-13640* National Aeronautics and Space Administration, Washington, D.C.
TRANSMISSION OF MEDICAL INFORMATION OVER LIMITED-CAPACITY TELEMETRY CHANNELS
R. M. Bayevskiy *In its* Aviation and Space Med. Dec. 1964 p 41–43 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The problem of transmitting medical information from a spacecraft to earth is discussed. The ideas of information theory are examined and methods of reducing the number of messages to be transmitted from a spacecraft are discussed. In particular, the construction of a symbolic code for medical monitoring on space flights is considered. P.V.E.

N65-13664* National Aeronautics and Space Administration, Washington, D.C.
THE PHYSIOLOGICAL-SANITARY JUSTIFICATION FOR SUBSTITUTING A LUMINOUS SUBSTANCE OF INTERMITTENT ACTION FOR THE PHOSPHOR NOW USED ON AIRPLANE INSTRUMENT DIALS
V. Ya. Gilinskiy and A. Ya. Loshak *In its* Aviation and Space Med. Dec. 1964 p 111–113 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The conclusions of the investigations are as follows: (1) Instrument panels painted with a luminous substance of constant action should be changed owing to the relatively high radioactivity. (2) Lighting instrument panels with luminous substances of intermittent action irradiated by UFO armatures is effective. (3) Of the two types of instrument panel lighting described, the more useful is the FKP-03K green-colored zinc sulfide. Author

N65-13674* National Aeronautics and Space Administration, Washington, D.C.
SELECTION OF INDIVIDUALS FOR FLIGHT TRAINING
T. T. Dzhamgarov *In its* Aviation and Space Med. Dec. 1964 p 136–138 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A combined study of certain motor abilities and individual psychological traits conducive to successful flight training was used as a basis for a new selection method, which incorporated a special physical training program to eliminate individual shortcomings revealed during the selection examination. Emphasis was placed on the motor abilities in conjunction with exercises involving diversion of attention and artificially stimulated emotional stress. This training led to better coordination and precision of movements, increased speed of movements and actions, and the ability to divide and switch attention, as well as to emotional stability and techniques of mastering tensions. The effectiveness of these methods was confirmed by the accuracy and the degree of effectiveness in forecasting highly successful flight candidates. G.G.

N65-13675* National Aeronautics and Space Administration, Washington, D.C.
THE POSSIBILITY OF SUBSTITUTING HELIUM FOR NITROGEN IN THE CABINS OF SPACECRAFT
A. G. Dianov and A. G. Kuznetsov *In its* Aviation and Space Med. Dec. 1964 p 138–140 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The feasibility of substituting helium for nitrogen in the microclimate of space cabins was studied on two groups of subjects who remained in a helium–oxygen mixture for 10 and 25 days, respectively. The heat exchange of the subjects was markedly affected, resulting in a cooling sensation with lowering of the skin temperatures. The heat comfort zone during daytime ranged from 24.5° to 27.5° C and at night from 26° to 29° C. The general sense of well-being, the behavior, and the efficiency of the subjects were not affected. A pronounced change was observed in the speech volume by the shift of the spectrum toward the higher frequencies by 0.7 octave. The clarity of speech deteriorated somewhat. It was concluded that man can remain up to 25 days in a pressurized cabin in which helium is substituted for atmospheric nitrogen. G.G.

N65-13690* National Aeronautics and Space Administration, Washington, D.C.
EVALUATION OF THE DEGREE OF TENSION IN PILOTS EXECUTING LANDINGS IN VARIOUS TYPES OF MODERN AIRPLANES UNDER ORDINARY CONDITIONS
L. S. Isaakyan *In its* Aviation and Space Med. Dec. 1964 p 179–184 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

In response to a questionnaire, individual pilots indicated the main factors in neuropsychic tension to be the physical efforts applied to control devices, the speed of planning and of the ground approach, and the total time used in completion of the landing during the final approach. The total impulse of the pilots' static efforts was computed by integrating the forces applied to the control wheel over a 20-second period spanning touchdown. The volume of information to be perceived and processed was combined with the time available during the approach and landing to obtain a logarithmic function. Various physiological parameters were measured in actual landings and were correlated with the calculated tension-producing factors. A relationship was found for which a mathematical expression was derived. D.E.W.

N65-13694* National Aeronautics and Space Administration, Washington, D.C.
OBTAINING VISUAL INFORMATION DURING INSTRUMENT FLYING
I. A. Kamyshev *In its* Aviation and Space Med. Dec. 1964 p 194–197 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The eye movements of six pilots in 16 circlings in a TL trainer were filmed with a motion picture camera. The motion pictures indicated that the gyroscopic horizon instrument was the most important since it was checked 35% to 70% of the time. It is recommended that the instrument panel be rearranged with the most frequently checked instruments grouped together. D.E.W.

N65-13697* National Aeronautics and Space Administration, Washington, D.C.
QUANTITATIVE EVALUATION OF OPERATOR IN A "MAN-MACHINE" SYSTEM
Yu. V. Kiselev *In its* Aviation and Space Med. Dec. 1964 p 204–205 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Criteria of reliability for mechanical devices are discussed, and a parallel criterion of reliability for human operators of equipment is stated: The best criterion of operator reliability in a continuous process is the probability that with correct input data the parameter of operator output will be within permissible limits at any moment of working time. In a discrete process, the criterion is the probability of correct performance of each cycle of operations. D.E.W.

N65-13712* National Aeronautics and Space Administration, Washington, D.C.
TRAINING MAN FOR SPACE FLIGHT
A. A. Koreshkov *In its* Aviation and Space Med. Dec. 1964 p 240–424 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

This report examines cardiovascular reactions during parachute training, exposure to vibrations, and prolonged confinement and isolation. The ability of a group of experimenters to work harmoniously together under these conditions is also reported. D.E.W.

N65-13714* National Aeronautics and Space Administration, Washington, D.C.
DEVELOPMENT AND PRESERVATION OF A HIGH LEVEL OF MOTOR FUNCTION AS A PROBLEM IN THE PREPARATION AND EXECUTION OF EXTENDED SPACE FLIGHTS
A. V. Korobkov *In its* Aviation and Space Med. Dec. 1964 p 245–247 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A study of the changes that take place in different organs and systems under conditions of hypodynamia and isolation showed that mental as well as motor and autonomic functions are affected. The marked decrease in resistance to radiation after hypodynamia indicated that the lack of physical movements and ensuing reflex and humoral stimulation exert a profound and unfavorable effect on essential processes in various organs and tissues. However, physical exercise during hypodynamia restores the quality of these functions. It was concluded from a second study that the stability of the internal environment is related to a high level of motor activity. D.E.W.

N65-13727* National Aeronautics and Space Administration, Washington, D.C.
SOME PHYSIOLOGICAL ASPECTS OF THE SYSTEM OF ASTRONAUT SELECTION AND TRAINING
A. V. Lebedinskiy, N. I. Arlashchenko, B. B. Bokhov, Yu. G. Grigor'yev, L. N. Kvasnikova et al *In its* Aviation and Space Med. Dec. 1964 p 284–289 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Because knowledge of the functional condition of the vestibular analyzer of body position and movement is important in the selection of astronauts, studies of the vestibular analyzer and its interactions were undertaken to (1) determine the threshold sensitivity of the semicircular canals to both positive and negative acceleration, (2) determine the functional state of the semicircular canals from analysis of reactions to deceleration following accelerations of various duration and magnitude, and to establish distinct vegetative reactions, (3) evaluate individual differences in the degree of vestibular adaptation to angular acceleration, and (4) test individual response to Coriolis acceleration. Studies indicating that retinal stimulation has an inhibiting effect on the vestibular analyzer and that the magnitude of the effect is determined by the degree of excitation of the vestibular analyzer are also reported. M.P.G.

N65-13738* National Aeronautics and Space Administration, Washington, D.C.
SOME PROBLEMS OF PROFESSIONAL SELECTION
V. D. Nebylitsyn and B. M. Teplov *In its* Aviation and Space Med. Dec. 1964 p 318–321 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

For efficient and effective selection of people for specific activities, it is necessary to predict two basic characteristics of the individual: first, his educational progress or his capacity for learning; and second, his efficient behavior under any complex situation including extreme conditions, i.e., his operational effectiveness. In order to determine the first characteristic, it is proposed that the individual's capacity for acquiring new habits and knowledge be measured rather than the habits he already possesses. The second quality is closely associated with the individual's neurophysiological characteristics; proposed measurements include emotional balance, self control, a sense of timing, capacity for concentration, psychic endurance, reorientation, etc. The significance of each characteristic is discussed. D.S.G.

N65-13743* National Aeronautics and Space Administration, Washington, D.C.
SOME STRUCTURAL PRINCIPLES OF FLIGHT CONTROL AND NAVIGATION SYSTEMS
Yu. A. Petrov *In its* Aviation and Space Med. Dec. 1964 p 333–335 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The design of instrument displays for aircraft equipped with automatic and semiautomatic control systems is discussed. To prevent overtaxing the pilot's attention with secondary information, the display should indicate only the emergency features of engine operation that require correction by the pilot. The pilot should be free to concentrate mainly on the location and position of the aircraft, the implementation of the preset flight program, the actual flying conditions in comparison with the prescribed ones, and the performance of apparatus installed in the aircraft. On this basis, the indicators on the display panel are classified as either information indicators, which extend the functions usually perceived by the sense organs, or command indicators, which alert the pilot to his next move. The choice of the type of display (signal lights, needle gages, command inscriptions, etc.) for these two types of indicators is discussed briefly. M.P.G.

N65-13748* National Aeronautics and Space Administration, Washington, D.C.
SOME REASONS FOR ERRORS MADE BY THE PILOTS IN INSTRUMENT FLYING
V. A. Ponomarenko and A. G. Shishov *In its* Aviation and Space Med. Dec. 1964 p 349–352 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

A study of over 50 cases of flying and navigation instrument failure shows that proper action by the pilot is frequently preceded by erroneous action. The erroneous action is shown to be due to a cause-and-effect chain of inertia in the signal system, delay in indicating the failure, psychological conflict between the incoming information and the pilot's perception, and prolonged mental and visual search for the reason for the contradictory information. Physical dissimilarities among the types of indicators further increase the probability of erroneous action. Possible indicators that would immediately alert the pilot to the fact that the failure is in the instrument and not in the aircraft parameter being measured are discussed. These include a tape with black and white stripes, whose motion is easily perceived by peripheral vision, and a sound signal system for emergency landing after instrument failure. M.P.G.

N65-13749* National Aeronautics and Space Administration, Washington, D.C.
SOME METHODS OF IMPROVING THE PERCEPTION OF PARAMETERS CONTROLLED BY A HUMAN OPERATOR
V. A. Popov, A. M. Pikovskiy, Yu. V. Kiselev, and Yu. V. Krylov *In its* Aviation and Space Med. Dec. 1964 p 352–355 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

The possible advantages of equipping flight instruments with auxiliary sound indicators is investigated. In such a system both the visual display and the tonal frequency should change continuously as the parameter being measured changes. Tests to measure human operator response to the dual indicator system show that combined visual and auditory indication improves the perception of the parameter by 6% to 11% as compared to either visual or auditory indication alone. In certain subjects the improvement amounted to 35% to 55%. The design of a dual indication system should be based on the fact that the differential audiofrequency threshold is not less than 0.02 of the frequency under investigation under conditions of background cabin noise. M.P.G.

N65-13753* National Aeronautics and Space Administration, Washington, D.C.
THE IMPORTANCE OF THE STUDY OF TYPES OF HIGHER NERVOUS ACTIVITY IN MAN IN SELECTING AND TRAINING FLIGHT PERSONNEL
A. A. Rogov, T. T. Gorlanova, M. M. Kantorovich, and N. T. Kovaleva *In its* Aviation and Space Med. Dec. 1964 p 366–368 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Vascular reactions to nonconditioned and conditioned stimulation were studied using subjects exemplifying Pavlov's nervous system types. Background plethysmograms furnished preliminary data for evaluating the chief characteristics of the nervous system. The pattern for the well-balanced mobile type of nervous system, the ideal type for astronauts, includes pronounced nonconditioned vascular reflexes which are characterized by a considerable drop in plethysmogram. Conditioned vascular reflexes in individuals with this sanguine type of

nervous system are distinguished by rapid formation and quick stability, with little change in magnitude after formation. As a rule they appear against a background of smooth plethysmograms. Differentiated inhibition is developed comparatively rapidly with 7 to 8 applications of negative inhibition, and the reflexes become stable after 42 applications of stimulations without reinforcement. The conditioned reflexes of phlegmatic, choleric, and melancholic individuals are also described. R.L.K.

N65-13772* National Aeronautics and Space Administration, Washington, D.C.
THE INFLUENCE OF AGE-ASSOCIATED CHANGES IN OLDER PILOTS DURING RE-LEARNING IN THE NEW AVIATION TECHNOLOGY AND DURING PERFORMANCE
A. V. Chapek, V. P. Yerokhin, and I. P. Poleshchuk *In its* Aviation and Space Med. Dec. 1964 p 419–421 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

Pilots aged 40 to 50 years were compared with a 30- to 39-year old control group in higher nervous activity, memory, shifting of attention, visual sequential form, cerebral biopotentials, arterial pressure, and in developing skill in estimating short intervals of time. Their flying progress and the quality of their piloting were also evaluated by instructors. The tests did not find a difference between the two groups which could have a negative influence on the process of relearning piloting in gas-turbine airplanes. However, restoration of functions of higher nervous activity after extended flights did proceed more slowly in the older pilots, and in a few older pilots there was some decrease in visual and hearing acuity, although not enough to be considered a negative influence on the quality of flying work. R.L.K.

N65-13776* National Aeronautics and Space Administration, Washington, D.C.
EFFECT OF PARACHUTE JUMPS ON THE ADAPTIVE REACTIONS IN PERSONS OF DIFFERENT AGE GROUPS
S. N. Shurgin and A. N. Mazin *In its* Aviation and Space Med. Dec. 1964 p 429–431 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

In comparing groups of men under 30 years of age with men 30 and over, emphasis was placed on changes in cardiovascular reactions and blood composition. The functional changes in the older groups, according to the electrocardiographic data, were more pronounced and they tended to persist into the restorative period. The systolic index increased by more than 10%. Sinus arrhythmia and instances of atrial extrasystole were noted after jumps. Investigation of the oculocardiac reflex and orthostatic test provided some information on changes in the tone of the parasympathetic and sympathetic nervous systems. In some of the men under 30, no significant fluctuations were noted in the tone of the parasympathetic nervous system. Sympathetic tone increased markedly during the jump procedure followed by a decrease after landing. In the men over 30, the parasympathetic tone increased, reaching a maximum after landing. There was a subsequent decrease, although normal tone was generally not restored by the second day after landing. The increase in sympathetic tone was less pronounced in this group. Pulse rate and blood effects are given for both groups. R.L.K.

N65-13779* National Aeronautics and Space Administration, Washington, D.C.
EFFECTIVENESS OF CERTAIN METHODS OF SELECTING PERSONNEL BY VESTIBULAR TESTS
Ye. M. Yuganov, S. S. Markaryan, I. I. Bryanov, I. A. Sidel'nikov, and R. A. Vartbaronov *In its* Aviation and Space Med. Dec. 1964 p 437–439 (See N65-13626 04-04) OTS: HC $7.63/MF $2.25

During flights, two types of vestibular reactions develop which may adversely affect the pilot's efficiency and physical fitness: illusions that make it difficult for the pilot to orient himself, and vestibular–autonomic reactions that cause a deterioration in his general condition. Several methods of vestibular selection are described and discussed. These are aimed at detecting any tendency toward spatial illusions and at determining the thresholds and intensity of vestibular reactions to the simultaneous inhibitory effect of stimuli from two analyzers (motor, visual, etc.). R.L.K.

N65-13955# Gt. Brit. Dept. of Scientific and Industrial Research. Warren Spring Lab.
HUMAN SCIENCES IN INDUSTRY. PART I: ERGONOMICS Annotated Bibliography
Sep. 1964 133 p refs

Included are abstracts of studies reported on in a variety of domestic and foreign professional journals, in conference proceedings, and in other documents. Categories cover ergonomics; systems of men and machines; visual inputs and processes; auditory inputs and processes; other sensory inputs and processes; input channels—choice and interaction; body measurements, basic physiological capacities, basic and complex motor performance; design of controls and integration with displays; layout of panels and consoles; design of work space, equipment, and furniture; clothing and personal equipment; special environmental factors affecting performance; individual factors, work conditions, and task characteristics that affect behavioral efficiency; training aids and devices and their use; personnel psychology and social psychology relevant to ergonomics. R.L.K.

N65-13965*# National Aeronautics and Space Administration, Washington, D.C.
EVALUATING THE STATE AND ACTIVITY OF CREW MEMBERS UNDER CONDITIONS OF PROLONGED SPACE FLIGHT [VOPROSY OTSENKI SOSTOYANIYA I DEYATEL'NOSTI CHLENOV EKIPAZHA V USLOVIYAKH DLITEL'NOGO KOSMICHESKOGO POLETA]
I. T. Akulinichev and R. M. Bayevskiy Jan. 1965 10 p Transl. into ENGLISH of a paper presented at the Fifteenth Intern. Astronautical Congr., Warsaw, 7–12 Sep. 1964
(NASA-TT-F-271) OTS: HC $1.00/MF $0.50

Discussed are the problems of operational medical supervision during space flight. New methods of investigating astronaut activity in controlling the spacecraft are described. These include analysis of coordination impairment in astronauts' handwriting and programed medical investigations. A flight measurement system is proposed and schematically represented. A new branch of space medicine—flight medicine—is suggested; it involves reciprocal monitoring of the condition of the crew during flight. R.L.K.

N65-13993# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
A COMPARISON OF PERFORMANCE IN OPERATING THE CRL-8 MASTER SLAVE MANIPULATOR UNDER MONOCULAR AND BINOCULAR VIEWING CONDITIONS
Gerald P. Chubb Oct. 1964 17 p refs
(AMRL-TDR-64-68; AD-608791)

Performance times were recorded for six subjects on a simple remote-handling task under two direct viewing conditions: binocular and monocular. All subjects performed under both conditions with counterbalancing between subjects and within subjects between sessions (I and II). The subjects used a CRL Model 8 master-slave manipulator to perform a shortened and revised version of the Placing Subtest of the Minnesota Rate of Manipulation Test. Performance times for the monocular viewing condition were 20% greater, exhibited greater variability, and reached an asymptotic level later. Author

N65-13995# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
EFFECTS OF DISPLAY POLARITY ON TARGET DETECTION WITH SIDE-LOOKING RADAR Technical Report, Jan.–Jun. 1964
Barbara A. Van Ausdall and Herschel C. Self Oct. 1964 38 p
(AMRL-TR-64-82; AD-609246)

Side-looking radar imagery was displayed on a 14- by 14-inch display at a scale of 1:176 000 and at 950 knots simulated aircraft speed. Nineteen SAC and TAC radar navigators were randomly assigned to two groups. One group was tested on a positive copy and the other on a negative copy of the same film. The average subject on the positive display detected significantly more targets (38.4%) than the average (32.1%) on the negative display. Target detection times on the positive display were significantly shorter. There was no significant difference between groups in number of responses to nontarget objects. For detections the distributions of confidence judgments were not significantly different; for nontarget objects the negative group was only half as likely to express high confidence that they were targets. For both types of display there were positive and significant correlations between maximum target dimension and probability of detection. Author

N65-13996# Air Force Systems Command, Wright-Patterson AFB, Ohio. Behavioral Sciences Lab.
HUMAN PERFORMANCE AS A FUNCTION OF INTENSITY OF VIBRATION AT 5 CPS Final Report, 31 Oct. 1963–11 Mar. 1964
Charles S. Harris, W. Dean Chiles, and Robert M. Touchstone Sep. 1964 17 p refs
(AMRL-TR-64-83; AD-607760)

The effect on human performance of whole-body vibration at a frequency of 5 cps was investigated. Ten subjects were tested on a two-dimensional tracking task at four double amplitudes of vibration, 0.08, 0.12, 0.16, and 0.20 inch. Only the two highest levels produced a decrement in performance. No subjective or performance aftereffects were found following any of the four 20-minute periods of continuous vibration. Author

N65-13997# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
CURRENT STATUS OF THE TECHNOLOGY OF TRAINING
Gordon A. Eckstrand Sep. 1964 33 p refs Presented at the 72d Ann. Conv. of the Am. Psychol. Assoc., Los Angeles 4–9 Sep. 1964
(AMRL-TR-64-86; AD-608216)

The processes involved in designing a training system are arbitrarily analyzed into the following three areas: (1) determining training requirements, (2) developing the training environment, and (3) measuring the results of training. In each of these areas, an attempt is made to summarize and evaluate the adequacy of the technology. Author

N65-13998# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
PILOT AIRCRAFT AIMING PERFORMANCE
Melvin H. Rudov Sep. 1964 17 p
(AMRL-TR-64-87; AD-608792)

Six test pilots, using a specially instrumented F-100D, flew nine dives each at a ground target. The task was to aline the aircraft with the target as quickly as possible. Initial altitude (7000, 8000, or 9000 feet), dive angle (10°, 20°, or 30°), slant range at alinement (6035 to 50 969 feet), and individual pilot differences did not affect accuracy of alinement. Turbulence, as judged by the pilots, decreased both accuracy and task time. Mean task performance time was approximately nine seconds, and mean accuracy was approximately five minutes visual angle. Author

N65-13999# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
A MECHANICAL IMPEDANCE INVESTIGATION OF HUMAN RESPONSE TO VIBRATION
Richard G. Edwards and Karl O. Lange (Kentucky U.) Oct. 1964 35 p refs Res. Conducted at Wenner-Gren Aeron. Res. Lab., Ky. U. under contract AF 33(616)-7766
(Contract AF 33(616)-7766)
(AMRL-TR-64-91; AD-609006)

To help establish the dynamics of the human body the mechanical impedance was measured as two subjects were exposed to vertical sinusoidal motion at frequencies from 1 to 20 cps. The impedance in the supine, lateral, and standing subject positions and its variation, due to voluntary change in muscle tone and to padding the support, were determined. In all tests the frequency interval from 5 to 7 1/2 cps was found to contain the initial whole-body resonance. Nonlinearity of the response, as established by impedance dependence upon shake table acceleration level, was observed by altering the peak shake table acceleration from 0.2 to 0.35 to 0.5 g. The degree of nonlinearity was found to be dependent upon subject position, as well as subject physiological differences. Changes in support padding and muscle tone produced substantial alterations in impedance but little variation of resonant frequencies. Author

N65-14000# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
INFLUENCE OF FIRST TASK PRACTICE AND INTERTASK SIMILARITY ON TRANSFER OF TRAINING IN A SYMBOL SUBSTITUTION TASK
Marvin Levine, Ross L. Morgan, and Alan D. Neiberg Oct. 1964 23 p refs
(AMRL-TR-64-96; AD-608598)

This experiment investigated the effects of degree of learning of a first task and degree of similarity between two tasks on the transfer of training from the first to the second task. The basic relationship between the two tasks was such that learning the first might well interfere with learning the second. Twelve groups of 15 college students learned a symbol substitution task to one of four levels of mastery. They were then transferred to a task where the symbols in task I were rearranged to permit three degrees of intertask similarity. Extensive and persistent negative transfer was obtained. During the initial stages of learning task II, negative transfer seemed to decrease as the degree of learning of task I increased. However, during the later stages of task II, negative transfer seemed to increase with an increase in the degree of learning of the first task, especially with the higher degrees of learning of task I. The intertask similarity variable appeared to be significant only during the early stages of learning the second task. Author

N65-14001# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
A PRELIMINARY STUDY OF THE EFFECTS OF BRIEFING LEVELS ON RECONNAISSANCE PERFORMANCE WITH SIDE-LOOKING RADAR Technical Report, Jan.–Mar. 1964
J. C. Welch and Don F. Mc Kechnie Oct. 1964 25 p ref
(AMRL-TR-64-101; AD-608887)

Sixteen Air Force navigators were tested, after appropriate training, on four strips of side-looking radar imagery. The imagery, at a scale of 1:197 000, moved across a backlighted 14- by 14-inch screen at 3.3 inches per minute, corresponding to 500 knots. The subject's task was to identify all air fields, bridges, tank farms, power lines, and railroad yards. The speed and accuracy of locating and identifying these targets under four different levels of briefing were assessed. The four briefing levels were: none, 10 minutes study of the corresponding chart prior to the simulated flight, access to the chart during but not prior to the flight, 10 minutes study of the chart prior to the flight and access to it during the flight. Fifty-six percent of the targets were correctly identified. On the average the target traveled 3.1 inches (56 seconds) after first appearing on the screen before being identified. False positive responses averaged 30%. Author

N65-14002# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
ABSOLUTE JUDGMENTS OF LIGHT INTENSITY Technical Report, Aug. 1963–Jul. 1964
Richard E. Wienke Oct. 1964 13 p refs
(AMRL-TR-64-103; AD-609050)

The assumption was made that absolute judgments of luminance could be made providing the eye remained in a relatively constant state of dark adaptation during the judgmental process. This hypothesis was tested by presenting each of 12 naive subjects with a preselected, random series of five stimuli which ranged from stellar magnitude 2.30 to 5.33. Each subject made 200 judgments at the approximate rate of three per minute. Results indicated two stimuli lying about 0.90 stellar magnitudes apart were confused, but near certainty of discrimination occurred when two stimuli were separated by approximately 1.40 stellar magnitude. Author

N65-14003# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
THE EFFECT OF TEST TRIALS ON THE LEARNING OF PAIRED ADJECTIVES Technical Report, Jul. 1963–Aug. 1964
Kirk A. Johnson Oct. 1964 21 p refs
(AMRL-TR-64-105; AD-609317)

Three experiments were conducted to determine the extent to which blocks of test trials contribute to the learning of paired adjectives. The results were compared to those found in an earlier study of the relative effectiveness of various modes of the subject-matter trainer. The earlier study indicated that learning by means of the quiz mode, under conditions in which blocks of trials in the quiz mode were alternated with blocks of test trials, was considerably superior to learning by means of several other modes, none of which involved test trials. In the present experiments, the addition of blocks of test trials to blocks of learning trials led to improvements in learning. This was true whether learning was by means of prompting or anticipation trials. The improvements were comparable in magnitude to the trial-by-trial differences found between the quiz mode and two of the remaining modes used in the previous study. Author

N65-14061# Illinois U., Urbana. Group Effectiveness Research Lab.
THE QUASI-THERAPEUTIC EFFECTS OF INTER-GROUP COMPETITION
James W. Julian, Doyle W. Bishop, and Fred E. Fiedler Oct. 1964 24 p refs
(Contract DA-49-193-MD-2060)
(TR-19; AD-608517)

Nine combat engineering squads competed in their training and garrison duties to test the hypothesis that intergroup competition promotes close interpersonal relations among group members and improves morale and adjustment. Eighteen squads for whom no changes in training were introduced served as controls. Questionnaire measures of interpersonal relations and adjustment were obtained before and after a 3-month experimental period. Changes in self-perception and reactions to military life indicated clearly the relative improvement in adjustment of the members of competitive squads as compared with members of control squads. Men trained under competitive conditions also had a lowered level of manifest anxiety on the Taylor scale. Improvements in the quality of interpersonal relations was indicated by a significantly greater change in within-squad sociometric choices of combat leaders and work partners for the members of competitive squads. However, these improvements did not generalize to nontask aspects of relations among squad members. Author

N65-14083# New York U., N.Y.
ENCODING IN THE PERCEPTUAL (VISUAL) SERIAL POSITION EFFECT
Murray Glanzer Dec. 1964 20 p refs
(Contract DA-49-193-MD-2496)
(AD-609101)

On the basis of the verbal hypothesis, specific changes in the shape of the perceptual serial position curve were predicted as a function of encoding, or verbalization, length of the stimulus, and stimulus exposure time. The effects of post-stimulus delay, both with and without an interpolated task, were investigated. Using eight-place binary numbers, a group of 12 subjects was tested to evaluate the effect of these four variables—verbalization length, exposure times, delay time, and interpolated task during the delay. As predicted, increasing the verbalization length and shortening the exposure time have similar effects. They tilt the serial position curve up on the right. The presence of an interpolated task produces an overall increase without, however, any effect on the shape of the serial position curve. Post-stimulus delay, within the range used in this study, produces no clear or systematic effect. Author

N65-14119*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEASURED HUMAN TRANSFER FUNCTIONS IN SIMULATED SINGLE-DEGREE-OF-FREEDOM NONLINEAR CONTROL SYSTEMS
Hugh P. Bergeron, Joseph K. Kincaid, and James J. Adams Washington, NASA, Jan. 1965 44 p refs
(NASA-TN-D-2569) OTS: HC $2.00/MF $0.50

Tests have been made to determine the variations in the transfer function of human pilots in simulated single-degree-of-freedom tasks due to various nonlinearities introduced into the pilot control system. The subjects included test pilots and engineers. The results show that variations in the measured gains did not occur in direct proportion to the variations made in the nonlinearities. An abrupt change did occur, however, in the measured gains of two of the pilots at low saturated control torques. The measured data from the single-axis tests were applied to a multiloop problem. The results for this problem confirm the feasibility of this procedure. Author

N65-14175# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering

A MATHEMATICAL MODEL OF THE HUMAN BODY

Ernest Patrick Hanavan, Jr. (M.S. Thesis) Aug. 1964 85 p refs

(GA/PHYS/64-3; AD-605487)

A 15-segment, personalized, mathematical model of the human body was designed using 25 anthropometric dimensions. Center of gravity, moments and products of inertia, principal moments, and principal axes were determined. Results for 66 subjects are compared with experimental data. The center of gravity is generally predicted within 0.7 inches, and moments of inertia within 10%. A generalized computer program to calculate inertial properties of any subject in any body position is described. The inertial properties of 5 composite subjects in 31 body positions are given in a design guide. The IBM 7094 digital computer programs are included. Author

N65-14261# Joint Publications Research Service, Washington, D.C.

APPARATUS FOR ELECTROPHYSIOLOGICAL INVESTIGATIONS

D. D. Dauson, V. P. Podachin, and A. I. Rybalko 11 Jan. 1965 16 p refs Transl. into ENGLISH from the book "Mekhanizmy Kompensatornykh Prisposobleniy" Moscow, Acad. of Sci. USSR, 1964 p 193-202

(JPRS-28225; TT-65-30106) OTS: $1.00

A two-channel apparatus for electrophysiological investigations is described, consisting of a complex of apparatus permitting the investigation of spontaneous and induced phenomena in the nervous system and other tissues. The apparatus permits: (1) studying bioelectrical phenomena in the nervous system; (2) applying single and rhythmic electric stimuli of a prescribed magnitude; (3) observing visually simultaneous hearing and recording processes on moving and immobile film; (4) accurate regulating of the distribution of events within the limits of a prescribed cycle (up to 10 seconds ±1μsec). Author

N65-14282# Arizona U., Tucson.

AN INVESTIGATION OF THE TRACKING CAPABILITY OF A HUMAN PILOT

Walter Hansen (M.S. Thesis) 1964 61 p refs

(AD-603477) OTS: $3.00

This thesis investigates the tracking capability of human pilots and also arrives at suitable transfer functions that can be used as mathematical representations of a human pilot subjected to small perturbations in the pitching and rolling modes of flight. A simulator was constructed from salvaged aircraft parts and once completed represented a basic instrument flying configuration less the fact that the rudders were not free to move. The equations of motion were programed on an analog computer, and disturbances were fed into the system through the use of a function generator. Author

N65-14344# Aberdeen Proving Ground, Md. Human Engineering Labs.

HIGH-INTENSITY IMPULSE NOISE: A MAJOR PROBLEM

Robert F. Chaillet, George R. Garinther, David C. Hodge, and Fred N. Newcomb Aug. 1964 38 p refs

(TN-4-64; AD-450726)

This report describes the impulse sound-pressure-level problem created by modern firepower and presents techniques for partially attenuating these levels at crew positions. It also discusses the effect of high-intensity impulse noise on hearing. Author

N65-14350# Boeing Co., Wichita, Kan. Airplane Div.

SUBJECTIVE REACTION TO WHOLE-BODY VIBRATION. RESEARCH ON LOW FREQUENCY VIBRATION EFFECTS ON HUMAN PERFORMANCE

Robert E. Chaney Sep. 1964 86 p refs

(Contract Nonr-2994(00))

(D3-6474; AD-607462) OTS: $4.00

Ten male volunteers were utilized in a study of the perception of vibration. Four subjective reaction levels—perceptible, mildly annoying, extremely annoying, and alarming—were established. The Boeing Human Vibration facility, modified since previous tests, was the test instrument. Experimental controls and test methods were determined in a preliminary study. Subjective levels identified are generally at higher acceleration values than those of previous research. Possible reasons for the differences are discussed. Also, individual values established at a given subjective level are shown to be influenced by the magnitude of the immediately preceding vibration level. Physiological effects in the main correlate with previous findings. Author

N65-14366# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

A STUDY OF AUDITORY FATIGUE CAUSED BY HIGH-INTENSITY ACOUSTIC TRANSIENTS

Michael H. L. Hecker and Karl D. Kryter 15 Oct. 1964 37 p refs

(Contract DA-49-007-MD-985)

(Rept.-1158; AD-450707)

An experiment is described in which groups totaling 21 subjects were exposed to 100, 200, and 400 acoustic impulses presented at the rate of 1 impulse/sec at a peak intensity of 157 dB SPL. The impulse waveform featured a rise time of 0.25 msec and a positive pressure phase of 0.50 msec. Less TTS_2 was observed for these impulses than was reported by Carter and Kryter under comparable conditions for impulses having a longer rise time and a longer pressure phase. The variability of TTS_2 obtained in the present experiment, representing individual differences in susceptibility, was similar to the variability reported by Carter and Kryter. In addition to these topics, questions pertaining to the effects on TTS_2 of impulse repetition rate, number of impulses presented, and impulse intensity are also discussed. Author

N65-14407# Aberdeen Proving Ground, Md. Human Engineering Labs.

THE EFFECTS OF REPEATED CONFINEMENT ON THE PERFORMANCE OF MEN IN A TEMPERATE ENVIRONMENT

Samuel A. Hicks Aug. 1964 28 p refs

(TM-11-64; AD-450714)

This investigation is designed to determine changes in general combat-relevant performance as a result of sustained confinement in armored personnel carriers. The present study examined the effects of repeatedly confining a single group of subjects for a 12-hour period on each of five successive days. Ninety enlisted men took tests measuring equilibrium, stamina, gross motor coordination, and marksmanship. There were statistically significant losses in all areas after the initial confinement period. Subsequent confinements showed progressively smaller decrements until, at the end of the final (fifth) session, the subjects performed at the preconfinement level. It was concluded that repeated exposure to confinement produces an adaptation phenomenon that voids the obviously transient effects that accompany intermittent exposure. The results support those of a previous study in a hot-wet environment. Author

N65-14449*# Serendipity Associates, Los Angeles, Calif.
REQUIREMENTS AND CONSTRAINTS OF POTENTIAL ROLES OF SUPERSONIC TRANSPORT CREWS
Harold E. Price, Richard A. Behan, and William J. Ereneta Washington, NASA, Jan. 1965 384 p refs
(Contract NAS2-2209)
(NASA-CR-146) OTS: HC $7.00/MF $2.00

The principal sections of the report contain information on flight profiles, supersonic transport (SST) requirements and constraints, and potential roles of the SST crew. The discussion of flight profiles includes the anticipated flight profiles or flight envelopes for SST, descriptions of individual phases of the flight profile, and separate discussions of the sonic boom, and air traffic control factors as they affect the flight profile. Requirements and constraints expressed by many individuals and organizations are reviewed; a limited analysis is presented of each group of requirements and constraints as it affects the crew. Potential roles of the flight crew are described in terms of system considerations which affect the flight crew, crew role variables, operational considerations and the crew, crew composition, and flight deck concepts. D.E.W.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-13406 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMOCHEMISTRY PENTAHALIDES OF TANTALUM AND NIOBIUM
V. M. Amosov *In its* Nonferrous Met. 29 Jun. 1964 p 134–148 refs (See N65-13401 04-17)

Thermochemical calculations of processes involving pentahalides of tantalum and niobium are based on values for heats of formation appearing in the literature that show divergence of 50 to 70 kc/mole. Appraisal was made of reported determinations, and probable values for heats of formation and entropy of fluorides, chlorides, bromides, and iodides of the two metals are given, which are significantly higher than those previously reported. D.S.G.

N65-13407 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PURIFICATION OF ZIRCONIUM SULFATE SOLUTIONS FROM IRON AND OTHER IMPURITIES BY ELECTROLYSIS WITH A MERCURY CATHODE
A. I. Layner and M. A. Kolenkov *In its* Nonferrous Met. 29 Jun. 1964 p 149–157 refs (See N65-13401 04-17)

Electrolysis with a mercury cathode of contaminated zirconium sulfate solution permits quantitative separation of iron from the solution without losses of ZrO_2. With the increase of the cathode current density from 6 to 12 A/dm^2 at a constant anode current density, specific expenditure of power is sharply increased and the yield of iron with respect to current is lowered. No change occurs with further increase to 24 A/dm^2. Change of ZrO_2 concentration from 25 to 94 g/l does not affect the yield of iron with respect to current, but the productivity of the bath is increased almost 200%, and the specific power expenditure decreases about as much. Upon accumulation of over 1% of iron in the mercury, it is necessary to subject it to purification. D.S.G.

N65-13408 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OBTAINING RHENIUM COATINGS BY THERMAL DISSOCIATION OF ITS CHLORIDES
A. N. Zelikman and N. V. Baryshnikov *In its* Nonferrous Met. 29 Jun. 1964 p 158–170 refs (See N65-13401 04-17)

After the determination of the rate of evaporation and dissociation of rhenium pentachloride and the conditions under which the trichloride is formed, the effect of various coating process conditions for the deposition of rhenium on molybdenum and tungsten was investigated. The influence of base-layer temperature and concentration of $ReCl_5$ in the gaseous phase on the speed of deposition was determined. One of the important indicators characterizing the deposition of rhenium from the gaseous phase was found to be the degree of utilization of the chloride, i.e., the ratio of the quantity of rhenium deposited to the quantity evaporated in the form of the pentachloride. Samples were subjected to mechanical tests for a determination of the quality of the coatings; results indicated good adhesion between the rhenium coating and tungsten and molybdenum. D.S.G.

N65-13409 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF GAS MEDIUM ON RATE OF VOLATILIZATION OF GERMANIUM SULFIDES
M. D. Galimov and A. I. Okunev *In its* Nonferrous Met. 29 Jun. 1964 p 171–179 refs (See N65-13401 04-17)

The rates of volatilization of GeS in atmospheres of argon, carbon dioxide, and hydrogen were measured and found to be dependent on the composition of the gas phase. The maximum distillation speed takes place in a stream of hydrogen and the minimum takes place in argon. Inasmuch as the interaction of hydrogen with germanium monosulfide does not take place to a significant extent (the latter does not dissociate as in the case of GeS_2), the increased volatility rate is attributed to the molecular-kinetic properties of the medium; i.e., hydrogen increases the diffusion rate of the vapor and promotes the volatilization of the solid phase. This experiment demonstrates that higher speeds of distillation than those expected from consideration of the vapor pressure can be achieved in industrial processes if the correct gas composition is selected. D.S.G.

N65-13410 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN REMARKS ON THE PROBLEM OF HIGH PURIFICATION OF SILICON TETRACHLORIDE AND TRICHLORSILANE BY THE RECTIFICATION METHOD
L. A. Nisel'son *In its* Nonferrous Met. 29 Jun. 1964 p 180–187 refs (See N65-13401 04-17)

The design of a rectification column as a mass exchange apparatus for the purification of silicon tetrachloride and trichlorosilane is considered. The choice of column construction may be based on columns used for organic products whose properties are similar to the silicon chlorides, but allowance must be made for their specific properties of hydrolization and corrosion. Even where all the required measures are taken, the practical possibility of deep purification of silicon chlorides is limited by the fact that the relative volativities of several

impurities are close to unity. If a third specially chosen complement is introduced such that its volatility is below the volatility of the purified base, the process may be carried out as a rectified extraction process. D.S.G.

N65-13416 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AUTOMATIC INSTALLATION FOR STUDYING THE KINETICS OF OXIDATION IN SOLUTIONS

N. G. Tyurin and I. A. Kakovskiy *In its* Nonferrous Met. 29 Jun. 1964 p 239–241 (See N65-13401 04-17)

An apparatus is described that provides for the automatic recording of the quantity of oxygen consumed as a function of time during an oxidation reaction in a solution. The installation consists of a reaction vessel with a magnetic mixer, pressure and temperature regulators, an electrolyzer for the oxygen source, a counter and an adding device for measurement of the number of bubbles of oxygen, an electronic relay for control of the oxygen supply, and the recorder. Accuracy of the obtained results is within the limits of ±2.0%. The operation of the installation was checked using solutions of sodium sulfite of various concentrations and yielded results very close to the estimated values. D.S.G.

N65-13419# General Precision, Inc., Little Falls, N.J. Research Center

HIGH-TEMPERATURE RESISTANT POLYMERS Quarterly Progress Report, 1 Jul. – 30 Sep. 1964

J. Luloff and C. Vogel 15 Oct. 1964 31 p refs

(Contract NObs-90194)

(QPR-3; AD-607085)

The preparation of high-temperature stable copolymers containing metallophthalocyanine units in the backbone of the polymer chain is reported. Condensation polymer synthesis studies were initiated with an investigation of the dihydroxysilicon phthalocyanine–resorcinol system. A crystalline polymer intermediate was isolated and is being characterized. The synthesis of difunctional carborane and neocarborane comonomers for use in similar condensation polymerization reactions was actively pursued. The 6,9-bis(acetonitrilo)decaborane was prepared and converted sequentially to 1,2-bis(acetoxymethyl)-carborane and 1,2-bis(hydroxymethyl)carborane. Carborane was also synthesized by the basic permanganate oxidation of the carborane diol. An investigation of the titanium phthalocyanine system resulted in the isolation and characterization of the novel +2 valence compound PcTi. This compound is soluble and stable in sulfuric acid, forming a brown solution, but it can be oxidized in that medium to phthalimide by persulfate. Author

N65-13461# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE INFLUENCE OF ACIDS AND SODA ON THE DISINTEGRATION OF NITROGLYCERINE IN THE PRESENCE OF WATER

K. K. Andreyev and G. N. Bespalov *In its* Theory of Explosives 31 Jan. 1964 p 236–251 (See N65-13451 04-33)

The influence of acids (nitric, trichloroacetic, and oxalic) on the disintegration of nitroglycerine in the presence of water, and the influence of soda and chalk on disintegration of nitroglycerine in the presence of water were investigated. Conclusions reached include the following: (1) Nitric acid in small concentrations slightly accelerates decomposition of NG in the presence of water. Increased concentration of the acid to 0.1% leads to fast development of hydrolysis of the NG; at even larger quantities of acid, the development of oxidizing–reduction reactions after hydrolysis is accelerated. (2) Hydrolysis of NG is also accelerated by trichloroacetic and oxalic acids. (3) Neutralizing substances (soda, chalk) prevent fast development of hydrolysis and subsequent acceleration of gas formation as a result of the oxidizing–reduction reactions between the products of hydrolysis. P.V.E.

N65-13489# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

WATER AS AN OXIDIZER IN REACTIONS WITH INORGANIC SUBSTANCES

A. A. Shidlovskiy *In its* Theory of Explosives 31 Jan. 1964 p 763–767 refs (See N65-13451 04-33)

Reactions of water with various metals are reviewed, including boron, silicon, phosphorus, carbon, and arsenic. Oxidative reactions of water with the oxides of various elements, such as tin, niobium, carbon, sulfur, and phosphorus are discussed. Reaction heats for many cited reactions were calculated from reference works on thermodynamics. Water vapor can also oxidize metal hydrides, nonmetal hydrides, and the borides and silicides of many metals. D.E.W.

N65-13490# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BROADENING OF REGION OF APPLICATION OF THE THERMOCHEMICAL LAW OF CONSTANT DIFFERENCES PRECOMPUTATION OF UNKNOWN HEAT OF FORMATION OF SALTS OF AMMONIUM

A. A. Shidlovskiy *In its* Theory of Explosives 31 Jan. 1964 p 768–772 refs (See N65-13451 04-33)

Salts of potassium and ammonium ions were synthesized, and the heats of formation were measured. The constant difference between heats of formation of potassium and ammonium salts of the same anions was found to be 28.4 kcal. This constant difference was used to calculate, from reference values of heats of formation of potassium compounds, the corresponding formation heats for the ammonium salts. Anions considered were rheniate, selenate, hexachlorostannate, tetrachloropalladiate, hexachloroplatinate, and hexafluoroaluminate. The accuracy of this type of preliminary calculation was ±2 kcal per g-equiv. D.E.W.

N65-13491 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

VAPOR PRESSURE OF NITRO DERIVATIVES OF BENZENE

Yu. Ya. Maksimov *In its* Theory of Explosives 31 Jan. 1964 p 773–778 refs (See N65-13451 04-33)

For determination of the vapor pressure of trinitrobenzene at various temperatures, a 0.05 g suspension of it was heated in a thoroughly evacuated (up to 10^{-3} to 10^{-4} mm Hg) and sealed glass vessel equipped with a manometer. The vapor pressure was also measured in a similar manner for mono and dinitro derivatives of benzene. The results of the measurements are presented in tabular form. The temperature dependence of vapor pressure of the nitro compounds considered can be expressed by the equation $p = Ae^{-\lambda/RT}$. P.V.E.

N65-13506# European Atomic Energy Community, Brussels (Belgium).

EXTRACTION OF THORIUM FROM AQUEOUS SULPHURIC-NITRIC SOLUTIONS WITH TRILAURYL-AMINE [ESTRAZIONE DEL TORIO DA SOLUZION: ACQUOSE SOLFORICO-NITRICHE MEDIANTE TRILAURILAMMINA]

F. Mannone and C. Stoppa Aug. 1964 43 p refs In ITALIAN; ENGLISH Summary
(EUR-1911.I) Available from Belg. Am. Bank and Trust Co., N.Y., Account No. 22.186: 40 Belg. Fr.

A study was made of the behavior of thorium in aqueous sulphuric–nitric solutions during extraction with 20% trilaurylamine (TLA) in dodecane. The batch tests were performed by alternative variation of the following parameters:

hydrogen-ion concentration (H+);
total anion concentration ($SO_4^{=} + NO_3^{-}$); and
percentage of nitrate ions relative to total anions
$NO_3^{-}/SO_4^{=} + NO_3^{-} \cdot 100$).

The experimental results show that the thorium distribution coefficients are lower than 10^{-3}; the TLA nitrate extracted in the organic phase is more stable than TLA sulphate; and the uranium–thorium separation under these conditions can be best achieved if the starting solutions have low concentrations of hydrogen ions and total anions and a low percentage of nitrate ions. Author

N65-13522# Los Alamos Scientific Lab., N. Mex.
THE SPECTROPHOTOMETRIC DETERMINATION OF TRACE AMOUNTS OF NICKEL IN TANTALUM METAL
Ross D. Gardner, Carter H. Ward, and William H. Ashley 2 Nov. 1964 12 p refs
(Contract W-7405-ENG-36)
(LA-3152) OTS: $1.00

The spectrophotometric method for the determination of nickel by use of dimethylglyoxime was modified and applied to the determination of trace amounts of nickel in tantalum metal. In this method the tantalum is dissolved in a mixture of hydrofluoric and nitric acids and is kept in solution with citric acid after removal of most of the hydrofluoric acid by gentle heating. Interference from any remaining hydrofluoric acid is eliminated by complexing it with boric acid. The analysis of 45 known solutions containing from 5 to 100 micrograms of nickel and 0.2 to 1 gram of tantalum showed an average recovery of 100.1 percent with a standard deviation of 1.4 percent of the nickel present. Author

N65-13548*# Fordham U., New York, N.Y.
[RESEARCH ON ANALYSIS OF THE ORGANIC AND INORGANIC COMPONENTS OF CARBONACEOUS AND OTHER SELECTED STONY METEORITES] Final Report, Nov. 1, 1962–Oct. 31, 1963
Bartholomew Nagy, Douglas J. Hennessy, and George Claus [1963] 2 p refs
(Grant NsG-341)
(NASA-CR-59949) OTS: HC $1.00/MF $0.50

The results of various methods of analysis of the Orgueil and Ivuna carbonaceous meteorites are presented. The mineral composition and texture of the two meteorites suggests an aqueous and low-temperature environment on the meteorite parent body. Some indigenous particles in the meteorites contained acid-insoluble residues that appear to consist of organic matter. Ultraviolet ultramicrospectroscopic analysis of these residues showed absorption bands at 260 and 280 mμ wavelengths. This may indicate, but does not prove, the presence of nucleic acid and protein constituents. G.G.

N65-13563*# George Washington U., Washington, D.C.
ORGANIC COMPLEXES OF TRANSITION METALS FOR OPTICAL MASER MATERIALS Semiannual Research Report, 1 Apr.–30 Sep. 1964
N. Filipescu 7 Oct. 1964 2 p
(Grant NsG-603)
(NASA-CR-59791) OTS: HC $1.00/MF $0.50

Transition metal complexes and chelates synthesized include rare-earth β-diketonates, α,α'-dipyridyl complexes, β-ketomines, α,α'-diquinolyl complexes, and tris-cyclopentadienyl–rare-earth complexes. Absorption spectra of α,α'-dipyridyl, α,α'-diquinolyl, and β-ketoimine complexes were determined in absolute ethanol in the UV–visible range with a Cary 14 spectrophotometer. Solvent and temperature effects on the fluorescence intensity of Europium β-diketonates were evaluated in the boiling point–freezing point temperature range in 10 solvents with different dipole moments. Theoretical work is in progress on the interpretation of the intramolecular energy transfer in β-diketonates based on fluorescence, phosphorescence, and absorption data. The effect of substituents in the different stages of the intramolecular energy migration as well as symmetry, efficiency, and transition probability problems is under consideration. Energy level calculation for rare-earth–tris-cyclopentadienyl complexes is also being pursued. R.L.K.

N65-13566# Polytechnic Inst. of Brooklyn, N.Y.
COPOLYMERIZATION WITH TRANSITION METAL CATALYSTS SYSTEMS AND ALKALI METALS AND ORGANO-ALKALI METAL COMPOUNDS Semiannual Progress Report No. 6 (Terminal), 1 Oct. 1963–31 Mar. 1964
C. G. Overberger, P. A. Jarovitzky, G. Khattab, and N. Yamamoto [1964] 69 p refs
(Contract DA-ARO(D)-31-124-G27)
(AROD-3041-4; AD-606287)

The 4-Trifluoromethylpentene-1 and 5, 5, 5-Trifluoropentanol-1 were synthesized and characterized; 3-Trifluorobutene-1 was copolymerized with 3-methylpentene-1 and with pentene-1. A theoretical molecular weight dependency on monomer and catalyst concentrations has been calculated for metallic lithium initiated polymerizations. Polymerizations were carried out with various amounts of lithium dispersion and fixed amounts of the other components. By combination of the observed polymerization rates and the observed degrees of polymerization, the rate constant for the anionic propagation was calculated as 40 1/mole·min at 35° C. Author

N65-13783# Naval Research Lab., Washington, D.C. Electrochemistry Branch
A STUDY OF ADSORPTION AND OXIDATION OF CARBON MONOXIDE ON PLATINUM USING CONSTANT-CURRENT PULSES Interim Report
T. B. Warner and S. Schuldiner 24 Apr. 1964 11 p refs
(NRL-6058; AD-605708)

Using single anodic constant-current pulses, the steady-state concentration of both the carbon monoxide already adsorbed on the surface of a bright platinum electrode immersed in 1 M H_2SO_4 and the additional amount of CO adsorbed during the application of the pulse have been determined. At potentials of 0.3 to 0.4 V relative to the normal hydrogen electrode, a surface coverage of one CO molecule per surface Pt atom was observed at very low CO partial pressures; for CO partial pressures up to 1 atm, the coverage increased to about 1.06 CO molecules per Pt atom, indicating that additional CO physically adsorbs on the base chemisorbed layer. At 1.0 to 1.3 V the rate of adsorption of CO was slower than the rate of diffusion (at 25°), and indirect evidence suggests that CO is not adsorbed at potentials above 1.3 V. The mechanism of oxidation of CO appears to be an electrochemical oxidation of water to form chemisorbed oxygen atoms, which then rapidly react with chemisorbed CO to form CO_2. Author

N65-13796# Aerospace Corp., El Segundo, Calif. Material Sciences Lab.
HIGH TEMPERATURE DEGRADATION OF PHENOLIC-CARBON
F. M. Wachi and D. E. Gilmartin 28 Oct. 1964 20 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-250; TDR-469(5250-40)-1; AD-452551)

The degradation of phenolic carbon was investigated at 2100° C under a nonoxidizing (N_2) and an oxidizing (air) atmosphere at a pressure of 1 atm. A comparison of the gaseous degradation products indicated that phenolic carbon undergoes oxidative degradation even in the absence of free oxygen at 2100° C. When phenolic carbon is heated under a nitrogen atmosphere, at least 17% of the total mass loss (24 gm per 100 gm of sample) may be ascribed to low-molecular-weight aliphatic and aromatic hydrocarbons. A large fraction of the remaining 83% of the total mass loss may be attributed to high-molecular-weight hydrocarbons as evidenced by the tarry substances deposited on the walls of the apparatus; the remainder may be attributed to H_2, CO, and H_2O. Since these hydrocarbons may be regarded as sources of CH radicals in an oxidizing atmosphere, it may be concluded that a sufficient quantity of ablation products is available for the generation of electrons by chemi-ionization in the wake of reentry vehicles whose heat shields are fabricated from phenolic carbon.
Author

N65-13797# Monsanto Research Corp., Dayton, Ohio. Dayton Lab.
RADIATION POLYMERIZATION OF ACETYLENE DERIVATIVES Final Report, 2 Oct. 1962–2 Apr. 1963
M. E. Gutzke and W. H. Yanko 26 Apr. 1963 22 p refs
(Contract NObs-88166)
(MRC-DA-16; AD-404863)

Research on the radiation-induced polymerization of acetylene derivatives to produce polyene polymers with useful properties concerned synthesis of acetylene derivatives, thermal, chemical, and radiation-induced polymerizations and copolymerizations of selected acetylene derivatives, and characterization and evaluation of the prepared polymers. Diethynylbenzenes were prepared and used as crosslinking agents in these polymerizations to insure solid products. Radiation yields with G values (number of monomer molecules polymerized per 100 eV of absorbed radiation) greater than 100 were observed in the copolymerizations of p-diethynylbenzene–propiolic acid (296) and p-diethynylbenzene–dimethylethynylboronate (136) systems. Two polymeric systems, p-polyphenyl and polyferrocene were prepared chemically, and are included in this study.
Author

N65-13839# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYTICAL PRODUCTION CONTROL IN THE NITROGEN INDUSTRY
S. S. Markov and Ye. V. Valikova 13 Feb. 1963 140 p refs
Transl. into ENGLISH of "Analiticheskiy Kontrol' Proizvodstva v Azotnoy Promyshlennosti", no. 12, 1960 p 1–229
(FTD-TT-62-1808/1+2+4; AD-299676)

A potentiometric method is described for measuring the redox potential of the system HNO_3–N_2O_4–H_2O, and analysis methods are given for the intermediate and initial products in the direct synthesis of concentrated nitric acid, for pure N_2O_4, and for pure HNO_3. The method proposed for analyzing the nitric acid–nitrogen tetroxide–water system is based on a determination of the nitrogen oxide content by a chemical method and on a measurement of the redox potential of the analyzed solution. The water content is calculated from a table, and the nitric acid content is computed from the difference between the water content and the total. The accuracy of this method of determining water content is ±0.05% to ±0.1% by weight. This method can be used for automatic control of the production of concentrated nitric acid.
D.E.W.

N65-13896 Joint Publications Research Service, Washington, D.C.
THE ROTATIONAL SPECTRUM AND THE ABSORPTION RATE OF DIMERS OF WATER VAPOR IN THE ATMOSPHERE. I: DIMER CONFIGURATIONS WITH LINEAR HYDROGEN BONDING
A. A. Viktorova *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 29–43 refs (See N65-13892 04-07)
OTS: $6.00

A model of a water vapor dimer is considered within the framework of the theory of hydrogen bonding. The mutual orientation of the molecules and the potential barrier of the internal rotation is calculated on the basis of a point model of a water molecule. The accuracy of a point approximation is evaluated.
Author

N65-13897 Joint Publications Research Service, Washington, D.C.
THE ROTATIONAL SPECTRUM AND ABSORPTION RATE OF DIMERS OF WATER VAPOR IN THE ATMOSPHERE. II: DIMER CONCENTRATIONS
A. A. Viktorova *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 44–55 refs (See N65-13892 04-07)
OTS: $6.00

On the basis of a general law of mass action, the general form of an expression for dimer concentration is described. The concentrations of water vapor dimers in the atmosphere are found.
Author

N65-13958# Washington U., Seattle.
UNIMOLECULAR DECOMPOSITION AND SOME ISOTOPE EFFECTS OF SIMPLE ALKANES AND ALKYL RADICALS
B. S. Rabinovitch and D. W. Setser [1963] 145 p refs Sponsored by NSF and ONR
(AD-607378)

A theoretical formulation for unimolecular reactions, using a quantum statistical transition state formula for the specific rate constant, is considered briefly. Emphasis is placed on the present state of the theory and the best techniques for simplifying the computations. Characteristics of various model hydrocarbon-type molecular species are outlined and used in theoretical calculations that illustrate various aspects of the theory. Some related aspects of kinetic isotope effects are considered using model calculations for hydrogen–deuterium substitution to illustrate the expected magnitudes and their nature. Consideration of these reaction processes shows that a given hydrocarbon species can be produced at many different pressures, in a variety of energy states, and with various hydrogen–deuterium isotopic compositions. It is shown how the specific rate constants are related to the experimental parameters of the various systems. The behavior of some C_1- to C_4-alkanes and alkyl radicals are calculated as examples of highly important practical systems.
D.E.W.

N65-13969# Tyco Labs., Inc., Waltham, Mass.
ELECTROCHEMISTRY OF FUEL CELLS ELECTRODES: THE USE OF LARGE ANODIC GALVANOSTATIC TRANSIENTS TO ELEVATE THE MAXIMUM ADSORPTION ON PT FROM HCOOH SOLUTIONS

S. B. Brummer Aug. 1964 40 p refs
(Contract Nonr-3765(00); ARPA Order 302-62)
(TM-13; AD-445787)

The adsorption on smooth Pt from HCOOH solutions in 1 N $HClO_4$ at 40° C has been studied with anodic and cathodic galvanostatic transients. During the application of a large anodic current, i_a, three processes contribute to the charge passed, C_a. These are (1) oxidation of adsorbate, (2) oxidation of a species in solution, and (3) surface oxidation of the electrode. By applying a cathodic current, i_c, at various times during the anodic transient, it is possible to measure (3) directly and, from the charge passed in deposition of H-atoms prior to H_2 evolution, changes in the concentration of adsorbed HCOOH can be followed. By varying i_a, the effect of (2) can be assessed. The contributions of processes (1), (2), and (3) can be effectively separated. The maximum adsorption from HCOOH solutions of a species which poisons the low potential oxidation of the HCOOH requires 310 μcoul/real cm^2 of electrode for its oxidation. Author

N65-13975# Bureau of Mines, Bartlesville, Okla.
RADIOACTIVE TRACERS IN MISCIBLE-PHASE PETROLEUM PRODUCTION OPERATIONS Interim Report
F. E. Armstrong, W. D. Howell, and Gordon E. Fletcher Washington, D.C., AEC, Nov. 1964 39 p refs
(Contract AT(49-11)-1964)
(TID-21199) OTS: $2.00

An investigation has been made to determine the utility of radioisotopes as tracers in the development of miscible-phase methods of petroleum recovery. Tritium was used in two field experiments to trace the flow of gasoline, of isopropanol, and of water. In one experiment, the relative vertical saturation of a producing formation with injected fluid was determined by analysis of liquids extracted from cores obtained from the formation during the test. In both field experiments, which are still in progress as of this date, considerable useful data were obtained. No major problems were encountered in actual tracer operations, although the synthesis and handling of large quantities of tagged hydrocarbons required special precaution to avoid contamination. Author

N65-13980# Iowa State U. of Science and Tech., Ames. Ames Lab.
A PROCESS FOR PURIFYING YTTRIUM METAL
O. N. Carlson, J. A. Haefling, and F. A. Schmidt Sep. 1964 16 p refs
(Contract W-7405-ENG-82)
(IS-984)

A process is described for purifying crude or scrap yttrium metal by first reacting the yttrium with fused $MgCl_2$ and then purifying the magnesium and YCl_3 products by codistillation. Dissolution and purification are carried out in a single heating step. The purified YCl_3 is reduced with calcium in the presence of the magnesium to form a Y-Mg intermediate alloy that is processed to yttrium sponge. Further refinement of the metal was obtained employing a salt extraction step and electron beam melting. Yttrium of 99.9+% purity was obtained from metal of 99.3% purity. Author

N65-13991# Technische Hochschule in Graz (Austria).
STUDIES OF PREPARATION AND PROPERTIES OF ACTIVE ALKALI AZIDES AND BARIUM AZIDE AND EFFECTS OF THIS ACTIVITY ON THERMODYNAMIC AND THERMOCHEMICAL DATA Monthly Technical Status Report No. 6, Oct. 1–31, 1964
Karl Torkar 18 Nov. 1964 8 p refs
(Contract DA-91-591-EUC-3320)
(AD-453948)

In an electron transfer from the azide ion to an electron trap, lattice defects, such as vacancies, foreign ions, and surfaces will influence the kinetics of decomposition, as they lead to changes in the periodic lattice potential. Such localized defects are the starting points for the formation of sodium nuclei at which further decomposition will occur. For discussion of the potential conditions a simple band scheme on the basis of a Kronig Penney model is used. Finally, the experimental results for the special case of foreign ion doping will be discussed with reference to the model used. Author

N65-14056# Michigan U., Ann Arbor. Coll. of Engineering
MgO-$MgFe_2O_4$ MICROSTRUCTURES
Howard Mc Collister and Lawrence H. Van Vlack Nov. 1964 11 p refs
(Contract Nonr-1224(47))
(Rept.-05612-1-T; AD-608560)

Magnesioferrite-periclase microstructures can be correlated to their thermal history. Grain-boundary precipitation occurs at higher temperatures, whereas a Widmanstätten precipitation is favored at lower temperatures. Magnesiowüstite, which is cooled slowly through the solubility limit, will first produce magnesioferrite at the grain boundary, followed by a Widmanstätten precipitate of magnesioferrite within the grains. Prolonged heat treatments at any temperature favor the spheroidization of the magnesioferrite within the periclase matrix. Author

N65-14071# Ohio State U. Research Foundation, Columbus.
THE INFRARED VIBRATION-ROTATION ABSORPTION BANDS OF METHYL CYANIDE AND METHYL FLUORIDE Scientific Report No. 3
Frederick Lynn Yarger Sep. 1964 144 p refs
(Contract AF 19(604)-6150)
(AFCRL-64-933; AD-609300)

The infrared absorption spectra of the methyl cyanide and the methyl fluoride molecules occurring in the 5- to 15-micron region were investigated with a high-resolution vacuum spectrograph. The ν_4, ν_8, ν_7, and $2\nu_8$ bands of CH_3CN, the ν_3 and ν_5 bands of CH_3F, and the ν_1, ν_2, ν_3, ν_5, and ν_6 bands of CD_3F were observed. Molecular constants were obtained for the molecules. Author

N65-14079# Metal Hydrides Inc., Beverly, Mass. Research & Development Labs.
SPECTROGRAPHIC ANALYSIS OF HIGH PURITY MATERIALS Final Report
James M. Morris 31 Aug. 1964 24 p refs
(Contract AF 19(604)-7998)
(AFCRL-64-23; AD-608655)

This report summarizes the investigations carried out to achieve increased spectrographic sensitivity for trace elements in high purity materials. Direct excitation of samples with the dc arc in air and in gaseous atmospheres was investigated. The reaction of chlorine on metal samples of Sn, Ga, and In to concentrate impurities was carried out. Also, an approach in which the impurities were released from a molten metal sample was tried. Author

N65-14082# United States Rubber Co., Wayne, N.J. Research Center

PHOSPHONITRILIC POLYMERS STABLE AT HIGH TEMPERATURES Final Report, 1 Nov. 1963–31 Oct. 1964

Harold K. Garner, Gerald J. Klender, and Aspet Merijanian 30 Nov. 1964 54 p refs

(Contract NObs-90089)

(AD-608942)

The objective of this investigation is the development of new thermoplastic and thermosetting resins from phosphonitrilic chloride trimer for high-temperature electrical applications. Polymers were prepared by linking together bifunctional phenyl- and phenoxy-substituted trimeric phosphonitriles. Linking groups include oxygen, nitrogen, hydroquinone, tetrahydroxyaromatics, and groups derived from the reaction of phosphonitrile isocyanates with glycols or diamines. The oxygen-linked and hydroquinone-linked polymers appear most promising. New syntheses of phosphonitriles of reduced functionality are reported. Author

N65-14097# Tracor, Inc., Austin, Tex.

ELECTROCHEMICAL STUDIES IN THE SYNTHESIS OF N-F COMPOUNDS Quarterly Status Report No. 6, 1 Apr.–30 Jun. 1964

Larry G. Spears, Larry D. Fiel, Wallace E. Harrell, Jr., and Gerhard M. Schmid 11 Nov. 1964 29 p refs

(Contract Nonr-4054(00); ARPA Order 339)

(TRACOR-64-304-U; AD-608222)

The work was devoted primarily to studying the anodic polarization of Monel in anhydrous hydrogen fluoride (AHF) and to the electrolysis of ammonium fluoride (NH_4F) in AHF using Monel as the working electrode. Conductance studies were also performed to determine the rate of contamination of the AHF as it was held in the sealed cells. Determinations of the effects of electrolysis and additions of water and NH_4F on the conductivity of HF were also made. Pyrolytic carbon was investigated as a possible electrode material. The carbon was mounted in Kel-F to expose only a single crystal plane, and, although it resisted attack by AHF, it disintegrated when fluorine was evolved anodically. Results to date indicate that fluorination during the electrolysis of NH_4F in AHF proceeds by chemical rather than by an electrochemical mechanism. Author

N65-14141# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Aero Propulsion Lab.

STUDY OF THE FEASIBILITY OF A TECHNIQUE FOR DETERMINING THE IMPURITY CONTENT OF LIQUID ALKALI METALS Technical Documentary Report, Mar. 1963–May 1964

Richard H. Herald Sep. 1964 29 p refs

(APL-TDR-64-101; AD-608863)

Recent studies revealed that the presence of impurities in alkali metal systems alters the thermophysical properties, accelerates corrosion, and may impair mechanical and thermal performance of equipment. In view of the problems, an investigation is made of a technique for identifying and measuring oxygen impurities in alkali metal systems at concentrations as low as 10 ppm. Specifically, the influences of oxygen impurities on the freezing points of potassium, rubidium, and cesium were studied theoretically and related to existing experimental data. An apparatus, which incorporates features for accurately measuring oxygen impurities in these alkalis by a freezing-point technique, is described along with the essential operating procedures. Author

N65-14196# National Academy of Sciences—National Research Council, Washington, D.C.

RADIOCHEMISTRY OF CHROMIUM

J. Pijck (Ghent U.) Washington, AEC, Dec. 1964 68 p refs

(NAS-NS-3007) OTS: $0.75

Reviews of nuclear and chemical properties of chromium are given, together with discussions of methods of sample dissolution and of separation reactions, descriptions of counting techniques, and a compilation of radiochemical separation procedures. Major sections of the paper are a *Table of Isotopes of Chromium*, a *Review of those Features of Chromium Chemistry of Chief Interest to the Radiochemist*, *Hazards and Precautions*, and *Counting Techniques*. D.E.W.

N65-14198# Union Carbide Plastics Co., Bound Brook, N.J. Research and Development Dept.

RESEARCH ON IMPROVED EPOXY RESINS Quarterly Progress Report (Summary Report, Phase I and II), May 1, 1963–Oct. 1, 1964

J. R. Harvey, W. P. Mulvaney, R. F. Sellers, and S. G. Smith, Jr. [1964] 40 p refs

(Contract Nonr-4172(00) (X))

(QPR-6; AD-607295) OTS: $3.00

The purpose of this program is to define the correlation of novel polyepoxide molecular configurations with the physical properties of cured resins as the initial step in providing significant improvements in filament-reinforced plastics for deep submergence structures. A discussion of the progress is presented relating the physical properties of cured specimens to the fourteen different types of molecular configurations investigated since the start of the program. The performance of each general configuration is discussed separately, and the known effects of resin quality, modifications, specimen preparation, and resin–hardener stoichiometry are included.. Author

N65-14219# TRACOR, Inc., Austin, Tex.

DEVELOPMENT OF A TRANSPARENT PRESERVATIVE COMPOUND FOR AIRCRAFT STRUCTURAL METALS Final Report

Robert R. Annand and Jimmie S. Payne, Jr. 27 Jun. 1963 13 p

(Contract NOw-62-0549-c)

(TRACOR-63-181-U)

The condensation of amines with carbonyl compounds was investigated with the goal of obtaining hydrocarbon soluble polymers containing the N-C-N (or gem-diamine) structure. Such polymers were obtained, and were shown to have promising properties for use as temporary protective coatings for metals. Author

N65-14268# Pennsylvania State U., University Park.

SEPARATION OF THE RARE EARTH ELEMENTS Final Report

[1963] 5 p

(Contract Nonr-65624)

(AD-607286)

The synthesis of aminoalkylarsines was investigated for their use as coordination compounds in the separation of rare earths. The functional groups desired were the three-aminopropyl- and the two-aminoethyl-compounds in order that six- and five-membered rings, respectively, could be formed by coordination involving both the nitrogen and arsenic atoms. A possible route for the preparation of three-aminopropyl arsine, the reduction of the corresponding two-cyanoethyl

arsines, was investigated. Also, condensation of the substituted arsine with ethyleneimine was studied for the preparation of two-aminopropyl arsines. Results of experiments on the reduction of haloarsines with lithium aluminum hydride are presented. D.S.G.

N65-14279# Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex. Dept. of Biochemistry
ULTRAMICRO METHODS IN BIOCHEMISTRY. III: THE DETERMINATION OF SERUM CHOLESTEROL. IV: THE DETERMINATION OF GLUCOSE
E. Van Stewart, Bernard B. Longwell, Agnes Wood, and Jeanette Storrs Oct. 1964 30 p refs
(Contract AT(29-2)-1013)
(LF-18) OTS: $0.50

Ultramicro procedures for the determination of serum cholesterol and of serum, plasma, or whole blood glucose are described. The chromogenic reaction of cholesterol with ferric iron was adapted to an ultramicro method. The results obtained with this procedure are compared to those obtained with a macro analysis which applies the chromogenic reaction of cholesterol with acetic anhydride and sulfuric acid in the presence of *p*-toluene sulfonic acid. Statistical evaluations of the method to determine reproducibility and variance are presented. The reliability of this method in the presence of elevated serum bilirubin was verified. One determination done in duplicate requires 20μl of serum. The color reaction obtained when glucose reacts with β-glucose oxidase in the presence of peroxidase and *o*-anisidine was evaluated for ultramicro analysis. Statistical evaluation of the precision of the method and variance analysis are presented, and the precautions necessary for reliable determination of glucose are emphasized. One determination done in duplicate requires 10μl of whole blood, serum, or plasma. Author

N65-14281# Texas A&M U., College Station. Activation Analysis Research Lab.
AN INVESTIGATION OF COMPUTER COUPLED, AUTOMATIC ACTIVATION ANALYSIS ANNUAL REPORT
Lloyd E. Fite, Richard E. Wainerdi, Pedro Jimenez, Wayne Wilkins, Maen To-on et al. 1 Jan. 1964 151 p refs
(Contract AT(40-1)-2671)
(TEES-2671-3) OTS: $5.00

The application of automation and computer methods to instrumental activation analysis is described. The grouping of equipment consists of a nuclear reactor, an automated gamma-ray spectrometer and sample transfer system, and an IBM 709 computer. Methods are described for sample preparation and for automatic system operation. Reported are the determination of silver in rat brain tissue, the determination of selenium in submicrogram quantities of sample, the determination of tellurium in blood, urine, and water, the determination of dysprosium used as an indigestible marker, and progress in the development of a probe to determine the composition of the moon's surface. A more advanced system for automatic activation analysis is described, which includes a high-speed memory-to-magnetic tape coupler, an IBM 753 magnetic tape control unit, and an IBM 727 magnetic tape unit. The dynamic subtraction of interfering spectra is discussed, a least squares curve fitting program is listed, and analog and digital techniques for high-speed accumulation of isotope data are described. D.E.W.

N65-14287# Mellon Inst., Pittsburgh, Pa.
POLYMER STRUCTURES AND PROPERTIES Technical Documentary Report, 1 Jan.–31 Dec. 1963
T. A. Orofino, G. C. Berry, A. Ciferri, E. F. Casassa, J. W. Mickey, Jr. et al Wright-Patterson AFB, Ohio. AF Mater. Lab., Sep. 1964 207 p refs
(Contract AF 33(657)-10661)
(ML-TDR-64-286, Pt. IV; AD-607418)

Theoretical and experimental investigations were made concerning properties of synthetic polymers in dilute solutions. The dependence of the molecular dimensions of linear polystyrene upon the nature of the solvent and temperature were studied under theta conditions—when the configuration is unperturbed by interactions of indirectly connected elements of the chain. A rather comprehensive study was made of the configurational, hydrodynamic, and thermodynamic behavior (as reflected by the second virial coefficient) of linear polystyrene in decalin over a sufficiently wide temperature range that the solvent character ranges from poor to moderately good. The data are used in assessing the validity of current theories. Author

N65-14293# Defence Chemical Biological and Radiation Labs., Ottawa (Canada). Power Sources Section
A REVIEW OF ZINC AS AN ANODE MATERIAL
G. L. Christie Jun. 1964 17 p refs
(TN-64-6; AD-444536)

A review of the published data on zinc anodes was made. Particular attention has been given to those references dealing with the causes of polarization or passivation. Author

N65-14302# Union Carbide Corp., Lawrenceburg, Tenn. Carbon Products Div.
IMPROVED GRAPHITE MATERIALS FOR HIGH-TEMPERATURE AEROSPACE USE Quarterly Progress Report, 1 May–31 Jul. 1964
P. G. Lafyatis et al 15 Aug. 1964 114 p refs
(Contract AF 33(657)-11171)
(AD-605942)

Several oxygen-substituted and quinone compounds were found to have extremely high reactivity. X-ray data for graphites prepared from model aromatic hydrocarbons were reevaluated. Complexing agents, p-benzoquinone and $SbCl_5$, produce a disordered graphite from aromatic hydrocarbons which otherwise result in highly ordered graphite. Thermal dehydrogenation curves are shown for fluoranthene, p-terphenyl, acenaphthylene, and bifluorenyl. Hydrogen content at 1000° C is related to the structure of the final graphite. Coupling constant assignments were made for the hexamethylbenzene, diazobenzil, and diazofluorene ESR spectra using the SESRS (Simulation of Electron Spin Resonance Spectra) computer program. Electrically conducting blacks seeded material produced a graphite with a markedly lower resistance than that obtained from material seeded with acetylene black. Two pilot-scale coker runs to produce high-thermal-expansion isotropic cokes were made. Author

N65-14332# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CLASSIFICATION OF THE SOLUBILITY OF ELEMENTS IN IRON
I. I. Kornilov 30 Mar. 1964 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Khim. (Moscow), no. 2, 1945 p 104–112
(FTD-MT-63-171; AD-602595) OTS: $1.00

The question of the solubility of elements of the periodic system in iron depending upon the relationship of their atomic diameters is considered. Elements which have a difference of atomic diameters not exceeding 8% of the atomic diameter of iron will form with iron continuous solid solutions; a difference from 8% to 15% is characterized by the formation of limited solid solutions, and in the case of a difference exceeding 20% the elements are not dissolved and are not alloyed. Author

N65-14349# Thiokol Chemical Corp., Denville, N.J. Reaction Motors Div.
SOLID PROPELLANT TRACING METHODS Semiannual Scientific Report, 15 Oct. 1963–14 Mar. 1964
David Fleischer Apr. 1964 30 p refs
(Contract AF 49(638)-1197)
(AFOSR-64-1954; AD-607636) OTS: $2.00

It is concluded from the investigation of the use of light absorption signals in motor exhausts for determining motor burning rates that erratic absorption and diffraction from solid particles and the shock structure in the exhaust prevent this method from yielding useful results. Work concerning the effects of trace species on the electron concentration in combustion gases was initiated. The systems of interest always contain low ionization potential impurities, whose concentration is affected by the formation of compounds, stable at flame temperatures. The effect of sodium chloride formation on the concentration of trace amounts of sodium was measured.
Author

N65-14352# Naval Civil Engineering Lab., Port Hueneme, Calif.
POTENTIODYNAMIC INVESTIGATION OF THE CORROSION OF IRON
Howard A. Porte 21 Sep. 1964 14 p refs
(Y-R011-01-01-035; N-625; AD-450221)

The anodic polarization of iron in sulfuric acid was investigated by the potentiodynamic method. Polarization was performed with an electronic potentiostat which was programed by a synchronous motor. The effects of potential traverse rate and direction, and electrode pretreatment are discussed.
Author

N65-14363# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF ANALYTICAL TECHNIQUES FOR THE DETERMINATION OF MINUTE QUANTITIES OF SELECTED ELEMENTS IN BERYLLIUM Interim Report, 20 May–20 Jul. 1964
W. M. Henry 7 Oct. 1964 17 p refs
(Contract NOw-64-0081-c)
(IR-3; AD-607585)

The efforts discussed in this report were principally in the areas of (1) the obtaining of additional high-purity beryllium materials, (2) development of a sensitive emission spectrographic technique, (3) additional effort in mass spectrography on evaluating plates and in the assembly of an electron-beam sample-cleaning gun, (4) the investigation of a vacuum-fusion extraction method to determine carbon in beryllium, and (5) the preparation of enriched-oxygen-in-beryllium standards.
Author

N65-14373# Wisconsin U., Madison. School of Pharmacy
RATE OF EXCHANGE OF CHLORINE BETWEEN DIMETHYLCHLORAMINE AND SUCCINIMIDE Final Report, 15 Jul. 1962–14 Jul. 1963
Takeru Higuchi and Jun Hasegawa 30 Jan. 1964 21 p refs Submitted for Publication
(Grants DA-CML-18-108-61-G22; DA-CML-18-108-G53)
(AD-450835)

Formation of dialkylchloramine in mixed aqueous solutions of dialkylamine and a halogenating agent may result either from a direct exchange of chlorine or through intermediate formation of hypochlorous acid. Thus, e.g., production of dimethylchloramine from dimethylamine and N-chlorosuccinimide (NCSI) may be written

$$Me_2NH + NCSI \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} SI + Me_2NCl \quad (1)$$

or

$$NCSI \rightleftharpoons HOCl + SI \quad (2)$$

$$HOCl + Me_2NH \rightleftharpoons Me_2NCl + H_2O. \quad (3)$$

Results of experimental measurement of these reactions suggest that (1) is normally the primary route. Values of k_1 and k_{-1} are reported as functions of pH. Author

N65-14379# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Div.
DEVELOPMENT OF NONFLAMMABLE HYDRAULIC FLUIDS AND LUBRICANTS Bimonthly Progress Report, Aug. 18–Oct. 17, 1964
H. F. Lederle 29 Oct. 1964 26 p refs
(Contract NObsr-90092)
(BMPR-6; AD-607489) OTS: $2.00

The addition of ethylene oxide or glycidol to tetrameric bis (p-hydroxyphenoxy) phosphonitrile resulted in the formation of water-soluble fluid products. The synthetic method for tetrameric bis (p-nitrophenoxy) phosphonitrile—an intermediate for water-soluble products—and improved procedure for the chloromethylation of trimeric bis (phenoxy)-phosphonitrile, and a method for converting the chloromethylated product to the corresponding hydroxymethyl compound were developed. Trimeric N-methyl-m-chloroanilino-2,2,2-trifluoroethoxy-phosphonitrile was prepared. This compound had a spontaneous ignition temperature slightly higher than trimeric N-methyl anilino-2,2,2-trifluoroethoxy-phosphonitrile. Utilization of a trimer-tetramer phosphonitrilic chloride mixture in place of the pure compounds for the synthesis of substituted aryloxy-2,2,2-trifluoroethoxy phosphonitriles was investigated and found to be feasible. Author

N65-14409# Tyco Labs., Inc., Waltham, Mass.
ELECTROCHEMISTRY OF FUEL CELL ELECTRODES. THE ELECTRICAL DOUBLE LAYER ON THALLIUM AMALGAM ELECTRODES
James N. Butler Oct. 1964 30 p refs
(Contract Nonr-3765(00); ARPA Order 302-62)
(TM-16; AD-450685)

Measurements of double-layer capacity and zero-charge potential were made on 10%, 30%, and 40% thallium amalgams. These results were compared with existing literature data. The integrated capacity curves agree with literature values for experimental electrocapillary curves. The surface concentration of thallium, at potentials where overvoltage measurements were made, is 1/2 to 3/4 of the bulk concentration. In contrast to results reported in the literature, the double-layer capacity of 40% thallium amalgam shows no dependence on frequency within experimental error in the range from 0.5 kc to 10 kc. Author

N65-14424# Kem-Tech Labs., Inc., Baton Rouge, La.
ATOMIC ABSORPTION SPECTROSCOPY Final Report
Apr. 1963 27 p refs
(Contract AF 30(602)-2426)
(RADC-TDR-63-209; AD-606049)

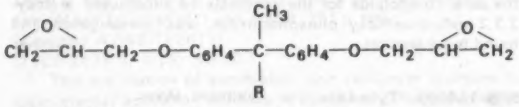
The report presents a discussion on the final instrumentation developed at Kem-Tech Laboratories. The detailed use of the instrument in actual analysis is described. Procedures and working curves are presented for aluminum, calcium, fluoride, lead, sulfate, copper, and magnesium. A list of 236 references is included. Author

N65-14440# Midwest Research Inst., Kansas City, Mo.
STRUCTURAL STUDIES OF INORGANIC OXIDIZERS Quarterly Report, 1 Jul.–30 Sep. 1964
F. I. Metz, F. E. Welsh, W. Rose, and J. Nebgen 4 Nov. 1964 14 p refs
(Contract AF 04(611)-10215; ARPA ORDER 24)
(QR-1; AD-450929)

The liquid systems OF_2 -NF_3, O_2F_2-NF_3, and O_3F_2-NF_3, O_3F_2-NF_3 were investigated. Pure OF_2, NF_3, F_2, and OF_2-NF_3 mixtures were subjected to electron paramagnetic resonance analysis, and the temperature dependence of the resonance signal produced by photolysis of OF_2 and OF_2-NF_3 was investigated. Liquid OF_2 showed a fairly strong, complex signal with a total line width of about 100 G. A sample of chromatographed liquid OF_2 prepared in normal room light showed a strong doublet with a peak to peak line width of about 2.65 G and a separation of 13.5 G. No signal was present when samples were purified in the dark. Liquid NF_3 did not exhibit an EPR signal, and photolysis of NF_3 failed to produce a resonance signal. No resonance signal is observed in equimolar mixtures of OF_2 and NF_3; however, photolysis of the mixture resulted in an EPR signal. P.V.E.

N65-14462# Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
COMPARISON OF KINETICS OF THERMAL DEGRADATION FOR A SERIES OF EPOXIDE RESINS
H. T. Lee, L. Reich, and D. W. Levi Dec. 1964 34 p refs
(TR-3197; AD-453629)

A series of diepoxides of the general structure



were prepared, where R is $-CH_3$, $-(CH_2)_6CH_3$, $-(CH_2)_{10}CH_3$, and $(CH_2)_{14}CH_3$. Thermal properties of these uncured diepoxides, as well as their cured resins, were studied by measuring weight loss under vacuum at several rates of heating. Overall activation energy and reaction order values for the degradations are tabulated and compared. Author

N65-14467# Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
CEMENTITIOUS CERAMIC MATERIALS
Ronald T. Hillhouse Aug. 1963 23 p refs
(PA-TM-1204; AD-414515)

A brief study of the chemistry of cementitious, or air setting, ceramic materials for protective coating and potting applications is presented. Included are the three main types of bonding mechanisms—reaction, precipitation, and hydraulic. Fillers which can be incorporated into the compound, as well as other physical and chemical characteristics of the materials, are considered. Two Air Force programs deal with cementitious materials. The first program is an attempt to develop inorganic air-setting adhesives for use to 1000° F. Results of this project indicate that shear values of 800 psi at room temperature and 1600 psi at 800° F may be expected. The second program, the development of a coating for thermal protection of structures to 3500° F, resulted in two promising acid-bonded oxide compositions. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-13426# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIOTELEMETRY
F. I. Barsukov and M. V. Maksimov 26 Nov. 1963 249 p refs
Transl. into ENGLISH of the book "Radiotelemetriya" Moscow, Voennoe Izd. Min. Oborony SSSR, 1962 p 1–183
(FTD-MT-63-189; AD-606279)

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N65-13427# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GENERAL INFORMATION ON RADIOTELEMETRIC SYSTEMS
In its Radiotelemetry 26 Nov. 1963 p 4–14 (See N65-13426 04-07)

The general principles of operation of a radiotelemetric system (RTS), and a functional diagram of the system are presented. The system includes data units of measurable magnitudes, a control parameter data unit, a coder, a radio transmitter, a radio receiver, a decoder, a registering mechanism, and a time block. The measured parameters to be transmitted by the RTS and the requirements for accuracy, reliability, speed, noise resistance, etc. are listed. The classification of the different types of systems is based on the division of channels, on forms of applied modulation, and on methods of registration of telemetered magnitudes. D.S.G.

N65-13428 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PICKUPS AND MEASURING DEVICES
In its Radiotelemetry 26 Nov. 1963 p 15–53 (See N65-13426 04-07)

Selection of the type and design of a pickup used in a radiotelemetric system data unit is determined by the type of conversion of the nonelectric quantities into electrical ones. The important characteristics of the following pickups are described: (1) ohmic pickups including potentiometric, tensometric, contact-resistance, thermistor, and electrolytic types; (2) inductance, magnetoelastic, and capacitance pickups; (3) oscillator pickups of the thermoelectric, inductance, and piezoelectric types; (4) photoelectric pickups; (5) radiation pickups; and (6) pickups involving combinations or multiple conversions. D.S.G.

N65-13429# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CODERS AND DECODERS OF RADIOTELEMETRIC SYSTEMS WITH FREQUENCY DIVISION OF CHANNELS
In its Radiotelemetry 26 Nov. 1963 p 54–97 (See N65-13426 04-07)

The principles of construction and operation of multichannel radiotelemetric systems with frequency division of the channels are given. The components of the coder, the generators of subcarrier oscillations, the modulators, and the summation device, are described in detail. Separation filters and demodulators are also discussed. Emphasis is placed on coders and decoders of radiotelemetric systems of the FM-FM type because of their widespread use. D.S.G.

N65-13430 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CODERS AND DECODERS OF RADIOTELEMETRIC SYSTEMS WITH TIME DIVISION OF CHANNELS
In its Radiotelemetry 26 Nov. 1963 p 98–149 (See N65-13426 04-07)

A functional diagram and accompanying explanation of the principles of operation are presented for multichannel radiotelemetric systems with time division of channels. Multivibrator circuits and blocking oscillator circuits used for generation of cadence pulses are described, as are mechanisms forming pulses from continuous sinusoidal oscillations. Switchboard-type modulator mechanisms which are used for commutation of the pickup circuits and for primary modulation are discussed, including mechanical, electronic, and cathode-ray types. Functional circuits are presented for coders and decoders of three types of radiotelemetric systems using pulse amplitude modulation. D.S.G.

N65-13431 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CODERS AND DECODERS OF R.T.S. WITH CODE DIVISION OF CHANNELS
In its Radiotelemetry 26 Nov. 1963 p 150–183 (See N65-13426 04-07)

The code method of the division of channels in radiotelemetric systems may involve codes formed from video pulses (time codes) or those formed from sinusoidal oscillations (frequency codes). The formation of these codes and the principles of operation of the systems using them are presented. Methods of decoding are also described. Functional diagrams and descriptions are given for coders and decoders of pulse phase modulation systems and pulse code modulation systems which use the code division of channels. D.S.G.

N65-13432 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CODERS AND DECODERS OF RADIOTELEMETRIC SYSTEMS WITH COMBINED DIVISION OF CHANNELS
In its Radiotelemetry 26 Nov. 1963 p 184–194 (See N65-13426 04-07)

Contradictory requirements of heterogeneous parameters to be transmitted in a radiotelemetric system may be satisfied by the use of combinations of the three methods of channel division—frequency, time, and code. The most widely used combination systems are those with frequency–time selection of channels; all the channels except one or two are used for transmission of fast alternating parameters and signals, and the remaining ones are used for transmission of the slow changing parameters. This system and the radiotelemetric system with code-frequency division of channels are described in detail. D.S.G.

N65-13433# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REGISTERING DEVICES AND DECODING OF RESULTS OF RADIOTELEMETRY
In its Radiotelemetry 26 Nov. 1963 p 195–224 (See N65-13426 04-07)

Telemetric signals can be registered in the form of continuous or discrete recordings. However, discrete recording methods are frequently used with a continuous form of modulation, and the continuous signal must be converted to a discrete one on the receiving end of the telemetric system prior to recording. The three stages of the complicated conversion process are described. Correction operations to compensate for errors introduced by the links in the telemetric system are carried out with registered data prior to recording. Devices for magnetic recording and the compensation of signal distortion due to instability of tape speed are discussed, as are oscillographic recording and its decoding. Methods of automatic decoding necessary to shorten processing time and provide immediate results are included. D.S.G.

N65-13434# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHARACTERISTICS OF THE RECEIVING-TRANSMITTING AND ANTENNA DEVICES IN RADIOTELEMETRIC SYSTEMS
In its Radiotelemetry 26 Nov. 1963 p 225–242 refs (See N65-13426 04-07)

The electrical requirements (wave bands, power, efficiency, and stability), and the design requirements as to dimensions

and weight and resistance to heat and vibration, are discussed for radio transmitters of telemetric systems. A functional circuit of a multistage transmitter is presented, and the components, which include a master oscillator, a buffer stage, frequency multipliers, a high frequency amplifier, a power amplifier, and modulator devices, are described. The important characteristics of transmitting antennas installed on aircraft and rockets and of several types of receiving antennas are given. The requirements and operation of a radiotelemetric system for testing long-range rockets are also discussed. D.S.G.

N65-13447# SAAB Aircraft Co., Linkoping (Sweden).
ANALOG SIMULATION OF TWO CONTROL SYSTEMS WITH STOCHASTICALLY TIME-VARYING LOOP GAIN OF INTEREST IN CONJUNCTION WITH RADAR
Clas Blohm Apr. 1964 19 p refs
(SAAB-TN-56)

Two types of control systems are treated: an automatic-gain-control (AGC) loop and a tracking loop, with stochastically time-varying loop gain. In order to verify some theoretical results obtained previously, the analysis is performed separately for the AGC loop and for the tracking loop containing a slow AGC. Results obtained agree well with theory. Furthermore, the tracking loop is studied when the speed of its AGC is varied, and it is shown that AGC bandwidth should be made approximately equal to tracking loop bandwidth in order to minimize the noise in the tracking error. Author

N65-13449*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A HYBRID RANGING SYSTEM FOR SPACECRAFT
R. T. Fitzgerald, P. Engels, W. Shaffer, E. Habib, and M. Mitchko Apr. 1964 47 p refs
(NASA-TM-X-55115; X-531-64-71) OTS: HC $2.00/MF $0.50

This report describes, in engineering terms, the principles and practice of satellite ranging by direct measurement of the elapsed time for a hybrid combination of sidetone-modulated and pseudorandom noise-modulated, cw, rf energy to travel from the ground to a spacecraft and back, after being transponded in a phase coherent manner at the spacecraft. The hybrid ranging system functions as follows: a demand pulse synchronized to WWV stores a binary pattern composed of transmitted bits and starts a time interval counter which is readied for stoppage when the identical signal is received. Simultaneously, sidetones harmonically related to one another are transmitted in alternately reversed phases, are received in reversed phases, and are used for vernier stop control of the time interval counter. Author

N65-13499# Microwave Associates, Inc., Burlington, Mass. Semiconductor Research and Development Dept.
LOW NOISE MILLIMETER DETECTOR Final Report
Clyde H. Brunquell 7 Jan. 1963 123 p refs
(Contract AF 30(602)-2651)
(RADC-TDR-63-44; AD-403139)

A circular waveguide formed the basis of the 2-mm detector design after preliminary comparison with existing rectangular waveguide detectors at 4-mm wavelengths. A waveguide diameter of 0.090 in., with a dumbbell type of adjustable shorting plunger was found to give the best performance. Test results of tangential signal, figure of merit, and conversion loss are reported. Results indicate that a 2-mm video detector can be fabricated with a −35 dBm tangential signal sensitivity at 10μA bias and 1-Mc video bandwidth. Calculations of the minimum detectable signal from figure of merit measurements indicate the goal of a minimum detectable signal of 10^{-10} watts was met. A harmonic generator and a calibrated 2-mm attenuator were constructed. The report contains design data for these components, and the results obtained from their use. Author

N65-13500# Martin Co., Baltimore, Md. Electronic Systems and Products Div.
OPTIMUM APERTURE STUDY Final Report
E. Lefferts and D. Lee Griffiss AFB, N.Y., RADC, Jun. 1963 57 p refs
(Contract AF 30(602)-2676)
(RM-235; RADC-TDR-63-188; AD-411252)

The applicability of the Wiener–Spencer theorem to antennas was studied. This theorem states that minimum standard deviation of the far-field power pattern occurs when the illumination function corresponds to the lowest mode of vibration of a membrane stretched across the aperture opening. This report studies various representative distributions and far-field power patterns for different antennas. Also presented are the analytical solutions of optimum illumination distribution for linear, square, circular, and elliptical antennas, and the respective expressions for far-field power diffraction pattern, and the zeroth and second moments. The illuminations and far-field patterns for the optimum and nonoptimum cases are plotted. A comparison is made of various nonoptimum distributions and the optimum distributions as determined by the Wiener–Spencer theorem. Moreover, estimates are given of the cost and effort required for the hardware implementation of the antennas with the optimum illumination. Author

N65-13513# Harvard U., Cambridge, Mass. Cruft Lab.
THE THEORY OF COIL ANTENNAS
Trilochan Padhi 1 Jul. 1964 21 p refs
(Contract Nonr-1866(26))
(TR-442; AD-607093) OTS: $1.00

A method is presented by which the distribution of current on some structurally simple coil or multiturn loop antennas may be obtained. The input admittances of unshielded and shielded coils are determined, and their operation as receiving elements is considered. Author

N65-13515# Dewey (G.C.) Corp., New York, N.Y.
AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF RADIATION ON THE PROPAGATION OF ELECTROMAGNETIC SIGNALS IN AIR Annual Technical Report
M. N. Hirsh, P. N. Eisner, and J. A. Slevin 30 Jun. 1964 91 p refs
(Contract DA 36-039-AMC-03278(E))
(R-173-4; AD-607071) OTS: $4.00

Steady-state and afterglow measurements of electron densities were made in O_2–N_2 mixtures weakly ionized by a spatially uniform flux of 1.5 MeV electrons from a Van de Graff accelerator. The plasma is contained in a large uhf resonant cavity to which mass and optical spectrometers are appended; electron densities are deduced from measured shifts in the resonant frequency of the cavity. The large cavity size minimizes wall effects, and ultrahigh vacuum techniques safeguard gas purity. Measurements made over the range 0.8 to 10 torr indicate that the predominant linear electron loss process is three-body attachment to O_2, with the coefficient $\beta N^2 = (2.1 \pm 0.4) \times 10^{-30} N^2 \sec^{-1}$, where N is the number density

of neutral O_2 molecules. The efficiency of N_2 relative to O_2 in stabilizing the attachment is $\xi = 0.06 \pm 0.03$. Mass and optical spectroscopic measurements were performed on the plasmas generated by the equipment, and results are given.
Author

N65-13516# ITT Federal Labs., Nutley, N.J. Ground Systems Lab.
SOLID STATE TACAN RECEIVER CODER Final Report No. 1
N.R. Ascione and J. C. Cozzie Bedford, Mass., AFSC, Electron. Systems Div., Feb. 1964 95 p
(Contract AF 19(604)-8352)
(ESD-TDR-64-235; AD-607184) OTS: $4.00

The design of a solid-state receiver coder for use as part of a TACAN ground station is given. A detailed description of the deliverable breadboard from both its physical and electrical aspects is given, together with test results obtained to date and recommendations for further development.
Author

N65-13798# Southwest Research Inst., San Antonio, Tex.
PERFORMANCE CHARACTERISTICS OF A SPACED LOOP ANTENNA FORMED BY TWO ARBITRARILY ORIENTED PARALLEL LOOPS Interim Development Report, 1 Jan. 1963–1 Apr. 1963
Douglas N. Travers 1 Apr. 1963 73 p refs
(Contract NObsr-89167)
(AD-407468)

This report has been prepared in order to make available in a single reference a complete listing of the important performance characteristics of the spaced-loop antenna. The exact field equations of a general space loop are derived and used as a basis for all other performance characteristics. The coaxial spaced loop and coplanar spaced loop are treated as special cases of the general analysis. Any two-loop spaced loop operating in the quadrupole mode may be treated as a special case. Field patterns are derived for near and far fields, for azimuth and elevation planes, and for both vertical and horizontal polarization, for any spaced loop. These results are plotted to show that certain space loops have pattern variations as a function of distance to the source. The field equations are then used to compute the radiation resistance, the effective height, effective area, gain, signal-to-noise ratio, noise figure, minimum observable field strength, and impedance. Other characteristics including reradiation error reduction, pattern variations with source distance, construction difficulties, and pattern distortion sources are reviewed.
Author

N65-13837# Federal Aviation Agency, Atlantic City, N.J. Systems Research and Development Service
LONG DISTANCE VHF COMMUNICATIONS SYSTEM TESTS AT BARNSTABLE, MASSACHUSETTS Interim Report
O. J. De Zoute Oct. 1964 67 p refs
(RD-64-139)

The capability and deficiencies of the long distance vhf communication system are analyzed and discussed in terms of equipment performance and meteorological dependence. Results of the tests indicated that to meet the program objectives, an additional system gain of approximately 40 dB is needed. Areas of equipment performance providing sources for system improvement are discussed. The test period climatology and measured meteorological factors are correlated with communications data. Recommendations are made to consider investigations for improvements to the system operation.
Author

N65-13840# Raytheon Co., Portsmouth, R.I. Submarine Signal Div.
ADAPTIVE DETECTION OF STATISTICAL SIGNALS IN NOISE
H. L. Groginsky, L. R. Wilson, and D. Middleton Jun. 1964 40p refs
(Contract Nonr-3381(00))
(R339; AD-601999)

The forms and properties were studied of a detector designed to operate in an environment in which little statistical information about either the signal or noise field is or can be available. An adaptive detector based on the theory of nonparametric statistics was designed. The detector uses amplitude samples taken from two distinct receivers, only one of which may contain signals from a target. The detector is shown to maintain constant false alarm rate despite any nonstationarity of the noise. This class of adaptive detectors demonstrates excellent performance in terms of signal detectability for signals of adequate strength. Signals weaker than a certain critical threshold cannot be detected with this adaptation scheme regardless of the amount of data available. The adaptive detector has a sharp minimum detectable signal threshold. The effect is due to the finite data sample that is used in the operation of the detector. Repeated use of the adaptive loop does not yield the same kind of improvement in detectability that is characteristic of increased integration time in conventional detectors. The theoretical results were entirely confirmed with a digital computer simulation. These computer results substantiate the validity of many of the assumptions needed to obtain analytic results.
Author

N65-13841# Hamburg U. (W. Germany). Instituts für Radiometeorologie und Maritime Meteorologie
INVESTIGATIONS OF ELECTROMAGNETIC WAVE PROPAGATION OVER LAND IN THE RANGE OF 500 MC/S WITH PARTICULAR CONSIDERATION OF METEOROLOGICAL CONDITIONS [UNTERSUCHUNGEN DER ELEKTROMAGNETISCHEN WELLENAUSBREITUNG IM 500 MHZ-BEREICH UBER LAND UNTER BESONDERER BERUCKSICHTIGUNG DER METEOROLOGISCHEN BEDINGUNGEN]
Gerda Fengler (Ph.D. Thesis) 1964 202 p refs In GERMAN

Field strength values observed during a 3-year period from four links were analyzed with the aid of routine simultaneous radiosonde measurements to determine the influence of meteorological conditions on wave propagation and to investigate the structure of the lower troposphere. A close relationship was found between the tropospheric structure derived from routine radiosonde measurements and the signal strength. It is concluded that the rough structure obtained by routine radiosondes is sufficient to explain the phenomena of uhf propagation; more exact quantitative investigations require special sondes or refractometers.
D.S.G.

N65-13850# Joint Publications Research Service, Washington, D.C.
THE QUESTION OF THE FEASIBILITY OF USING HIGH-BASE FREQUENCY CODES
Ye. G. Servinskiy 7 Jan. 1965 10 p refs Transl. into ENGLISH from Elektrosvyaz (Moscow), no. 10, 1964 p 41–46
(JPRS-28164; TT-65-30075) OTS: $1.00

An analysis was conducted of the dependence of the interference stability of a communications system with frequency manipulation upon the frequency code for the case of fluctuating interferences. Considered are the effect (on the nature of this dependence) of the state of a radio channel, the ratios of

the average signal powers, and specific interference at the receiver's input; also considered are the rates of information transfer and the relationships between the duration of the pulse and the bandwidth taken for each frequency. An improvement in the interference-free state (or reduction in the transmitter's power at retention of the former interference-free state) leads to an increase in the difficulties involved in the technical realization of a communications system. Author

N65-13895 Joint Publications Research Service, Washington, D.C.

OPTIMUM ANTENNAS OF MONOPULSE PHASE RADARS

V. I. Vodolazskiy and A. F. Terpugon *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 16–28 refs (See N65-13892 04-07) OTS: $6.00

A method is presented for obtaining information on the angle of a target for a monopulse phase radar from a comparison of the phases of the reflected pulses at the outputs of the spatially separated antennas. The presented case assumes that the mean value of the signal-to-noise ratio at the antenna output is known; that the noise at the antenna outputs is independent, normal, and interacts additively with the signal; that the angular position of the target is tied to one angle; and that the probability density for the angular position of the target is known. The optimum directivity patterns for antennas of monopulse phase radars ensuring a minimum error in the target determination were found. G.G.

N65-13902 Joint Publications Research Service, Washington, D.C.

COMPRESSION OF A RADIATION PULSE IN A DISPERSING MEDIUM WITH RANDOM INHOMOGENEITIES

P. V. Bliokh *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 97–112 refs (See N65-13892 04-07) OTS: $6.00

The compression of a pulse of a frequency-modulated signal in a dispersing medium with random inhomogeneities is considered. It is shown that for a path length greater than some critical value, the pulse always diffuses. The results obtained vary for the passage of a radio signal through the ionosphere. Author

N65-13903 Joint Publications Research Service, Washington, D.C.

RECIPROCITY RELATIONSHIPS FOR PARTIALLY-COHERENT ELECTROMAGNETIC FIELDS

L. S. Dolin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 113–124 refs (See N65-13892 04-07) OTS: $6.00

Reciprocity relationships are obtained for the correlation functions of a random stationary electromagnetic field. Certain possible applications of these relationships to diffraction problems for random fields are considered. Author

N65-13907 Joint Publications Research Service, Washington, D.C.

PASSAGE OF A NOISE SIGNAL THROUGH A SYSTEM WITH VARIABLE PARAMETERS

V. A. Markelov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 158–174 refs (See N65-13892 04-07) OTS: $6.00

Using the example of parametric regenerative and superregenerative amplifiers, the passage of a random process (white noise) through a system with periodically varying parameters is examined. Expressions are obtained for the correlation function and the spectrum of the periodic nonstationary process at the system output. The problem of detecting such a process is also considered. Author

N65-13908 Joint Publications Research Service, Washington, D.C.

ELECTROMAGNETIC WAVES OF FINITE AMPLITUDE IN COUPLED TRANSMISSION LINES WITH NONLINEAR PARAMETERS

A. M. Belyantsev and G. I. Freydman *In its* Izv. VUZoy: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 175–187 refs (See N65-13892 04-07) OTS: $6.00

Certain features of electromagnetic waves in coupled (multiwire) transmission lines are considered. Using the examples of two coupled transmission lines with nonlinear parameters, it is shown that in nonlinear multiwire transmission lines there may exist several types of simple and shock waves. In certain cases, electromagnetic shock waves may be nonevolutionary. Shock wave structure is investigated, and it is shown that a nonevolutionary shock wave into coupled transmission lines splits into two evolutionary shock waves propagating at the same velocity. Author

N65-13909 Joint Publications Research Service, Washington, D.C.

RADIATION FROM PROLATE SPHEROIDAL ANTENNAS

D. A. Duplenkov and S. N. Ivanov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 188–196 refs (See N65-13892 04-07) OTS: $6.00

The solution to the problem of exciting a prolate ideally conducting spheroid by a ring slot with uniform distribution of magnetic current is considered. Theoretical and experimental radiation patterns are given. Author

N65-13918 Joint Publications Research Service, Washington, D.C.

RADIATION OF DIPOLE ANTENNAS AT THE EDGE OF A WEDGE

A. N. Kovalenko and G. T. Markov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 258–266 refs (See N65-13892 04-07) OTS: $6.00

This paper investigates the radiation of a horizontal symmetric dipole, a vertical dipole, and a folded dipole; in all cases, it is assumed that the electric current in the dipole is sinusoidally distributed. Author

N65-13919 Joint Publications Research Service, Washington, D.C.

PROBLEM ON THE MEASUREMENT OF ANTENNA PARAMETERS ACCORDING TO THE RADIOEMISSION OF A "BLACK" DISK LOCATED IN A FRESNEL ZONE

N. M. Tseytlin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 267–270 refs (See N65-13892 04-07) OTS: $6.00

If the method normally used to measure the parameters of small antenna systems were applied to large antennas, it would require that the disk be placed at a large altitude and in the far zone of antenna field. The possibility of measuring

the parameters of large antennas with the disk located in the Fresnel zone when the exciter is moved away from the focus is discussed, as well as associated problems. Emphasis is placed on the measurement of the scattering coefficient. D.S.G.

N65-13930 Royal Armament Research and Development Establishment, Fort Halstead (Gt. Brit.)
MAGNETIC TELEMETRY FOR ATTITUDE MEASUREMENT IN A HYPERVELOCITY RANGE
C. R. Wall and B. J. Millen *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 16 p refs (See N65-13922 04-14)

A telemetry system is described in which a small bar magnet is carried on the model in free flight in a hypervelocity range. Signals induced by this magnet in pickup coils placed in the range provide data from which attitude parameters of the model may be deduced. Author

N65-13974# Federal Aviation Agency, Atlantic City, N.J. Experimentation Div.
LONG DISTANCE VHF COMMUNICATIONS SYSTEMS TESTS AT PALMER, PUERTO RICO Interim Report
O. J. De Zoute and Lloyd Pearson Oct. 1964 38 p
(RD-64-140)

The system capability is analyzed and discussed in terms of subsystem performance and some related meteorological factors. Results of the tests indicated that the significant rate of signal attenuation was 13.4 dB per 100 n.mi. and the associated average usable range capability was 517 n.mi. Some basic meteorological factors are correlated with communications data. Author

N65-13983# Joint Publications Research Service, Washington, D.C.
THE SPEECH SIGNAL IN CYBERNETICS AND COMMUNICATIONS
M. A. Saposhkov 5 Jan. 1965 691 p refs Transl. into ENGLISH of the book "Rechevoy Signal v Kibernetike i Svyazi" Moscow, Svyaz'izdat, 1963 p 1–453
(JPRS-28117; TT-65-30045) OTS: $9.90

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N65-14005# Sylvania Electric Products, Inc., Waltham, Mass. Sylvania Electronic Systems East
HARDENED ANTENNA STUDIES. ELECTRICAL INVESTIGATION OF HARDENED HF ANTENNAS Final Report 15 Mar. 1963–15 Mar. 1964
E. Tahan, R. Wundt, D. Myers, H. Zeltzer, J. Snitkoff et al Griffiss AFB, N.Y., RADC, Sep. 1964 335 p
(Contract AF 30(602)-2932)
(RADC-TDR-64-184, Vol. IA; F607-1; AD-607419)

This study resulted in the generation of efficient antenna techniques consistent with the capabilities to withstand the effects of nuclear weapons. The hf antenna techniques are useful throughout the 2 to 30 Mc frequency band; the uhf antennas operate in the 225 to 400 Mc region. The program was divided into two phases: (1) a theoretical study of antenna techniques which were investigated with regard to feasibility, configuration required, bandwidth possibilities, efficiency, radiation patterns, hardness ratings, debris effects, and economic analysis, and (2) the fabrication and test of electrical models of the most promising designs, resulting in design data and cost and hardness estimates for antennas for the hf and uhf bands. Author

N65-14009# Raytheon Co., Burlington, Mass. Spencer Lab.
X-BAND ELECTROMAGNETIC AMPLIFYING LENS Technical Documentary Report, 25 Feb.–25 May 1964
J. Skowron and N. Heenan Griffiss AFB, N.Y., RADC, Oct. 1964 28 p
(Contract AF 30(602)-2892)
(RADC-TDR-64-321; AD-608922)

Possible factors that could have contributed to the failure of the first X-band electromagnetic amplifying lens (EAL) to demonstrate the EAL principle are discussed in detail. A new tube, which incorporates a water-cooled anode and two water-cooled cathodes, and whose assembly is such that the anode–cathode spacing for both cathodes is everywhere uniform to within 1% or better, is described. Also discussed is additional work on the construction of bi-uniform millimeter-wave structures using a multiblade machine. P.V.E.

N65-14013# Melpar, Inc., Falls Church, Va.
FRESNEL ZONE ANALYSIS Final Report
L. L. Bonham et al Griffiss AFB, N.Y. RADC, Oct. 1964 328 p refs
(Contract AF 30(602)-3020)
(RADC-TDR-64-368; AD-608711)

This report presents the objectives and results of an investigation of the interference effects of Fresnel-region phenomena.

Analytical techniques are described that will enable calculation of Fresnel-region radiation patterns for monopulse antennas, elliptically or irregularly shaped apertures, and phased arrays. The results from investigations of defocusing techniques, radial E-field in the Fresnel region, effects of reflections in the Fresnel region, antenna to antenna coupling in the Fresnel region, and spurious frequency response are also presented. A unique measurement technique, called Fresnel ring focusing, is described, and gives testimony for a feasible means for obtaining the far-field pattern of a large aperture antenna with measurements taken well within the far-field-Fresnel region boundary. In comparison with other means using the Sommerfield expansion to produce such results, the Fresnel ring focusing technique appears to have many advantages, which are outlined. Author

N65-14016# General Dynamics/Fort Worth, Tex.
RADAR CROSS SECTION TARGET SUPPORTS—PLASTIC MATERIALS
C. H. Smith, C. C. Freeny, E. F. Knott, and T. B. A. Senior
Griffiss AFB, N.Y., RADC, Jun. 1964 120 p refs
(Contract AF 30(602)-2831)
(RADC-TDR-64-381; AD-608252)

The results of studies of the scattering properties of cellular plastic materials are presented. A mathematical model for scattering from cellular plastics to provide a method of determining the optimum low cross-section target support for a given application is also presented. The results of investigations of field perturbations near a Styrofoam surface are described along with cross-section measurements made at the RAT SCAT site using theoretical minimum cross-section formula for circular target supports. Structural considerations in the use of Styrofoam as target support material are discussed. Methods for achieving low cross-section bonds between pieces of Styrofoam are also discussed. The results of a limited study of the feasibility of air-inflated structures as target supports at the RAT SCAT site are also presented. Author

N65-14017# Sylvania Electric Products, Inc., Mountain View, Calif.
OPTIMIZED COHERENT OPTICAL RECEIVER TECHNIQUES Final Report
Griffiss AFB, N.Y., RADC, Oct. 1964 68 p refs
(Contract AF 30(602)-3162)
(RADC-TDR-64-390; AD-608412)

Presently available camera tubes are storage devices and are not capable of following the doppler frequency shifts, which may be in the microwave range. The only photodetector which has a suitable bandwidth is the traveling-wave phototube. The photodetector developed during this program is a combination of an image dissector electron gun and a traveling-wave amplifier. This electron gun was successfully operated as a video detector with a resolution comparable to present television standards. The complete scannable photodetector, including a helical slow-wave structure, was designed and fabricated. The device was evaluated in a direct optical modulation-demodulation experiment with a modulation frequency of 10.7 Gc. The detection of microwave-modulated light signals at any point on the photocathode was demonstrated with the tube operating in the scanning mode. A simultaneous display of video position signal and microwave modulation signal was achieved in a system simulating a radar receiver. Author

N65-14019# General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
ULTRA HIGH POWER TRANSMISSION LINE TECHNIQUES
John P. Quine Griffiss AFB, N.Y., RADC, Oct. 1964 39 p refs
(Contract AF 30(602)-2990)
(EH-61581; RADC-TDR-64-414; AD-608890)

The purpose of this investigation is to develop systematic procedures for selecting optimum waveguide configurations and designing waveguide components that will operate at high levels of peak and average power in the frequency range 1 to 10G. In the present report the design and fabrication of tapers, bends, and a 20-dB directional coupler for the experimental program is described. A description of a resonant cavity method for high-power testing is also presented. Author

N65-14020# Scientific-Atlanta, Inc., Atlanta, Ga.
PRECISION ANTENNA PATTERN RECORDING TECHNIQUES, PHASE II First Quarterly Report, 1 Jun.–28 Aug. 1964
Jack B. Chastain, J. Searcy Hollis, Samuel F. Hutchins, and Rezin E. Pidgeon, Jr. Griffiss AFB, N.Y., RADC, Oct. 1964 25 p refs
(Contract AF 30(602)-3425)
(RADC-TDR-64-420; AD-608475)

Progress is reported on a project to develop equipment to enhance the antenna measurement capability of ground-based antenna test ranges and to continue certain earlier theoretical studies. Subjects discussed include a stabilized transmitter, an amplitude measurement receiver, a panoramic display unit, a digital-to-analog converter, and a calibration and offset unit. D.E.W.

N65-14037# Illinois U., Urbana. Antenna Lab.
GYRO-INTERACTION ROCKET EXPERIMENTS IN THE LOWER IONOSPHERE Aeronomy Report No. 3
Ralph Richard Hodges, Jr. Nov. 1964 87 p refs
(Contract AF 19(628)-3900)
(AFCRL-64-653; AD-609327)

Two gyro-interaction rocket experiments were performed in the lower ionosphere. The basic experimental procedure consists of the radiation of periodic pulses of gyrofrequency energy from a transmitter within the rocket payload. The effect of each pulse is to produce a sudden disturbance of electron energy near the rocket. With the use of this technique, rate coefficients for two processes were evaluated. The rate of loss of excess electron energy was determined by this method. At altitudes above the sensing wave reflection level, cross-modulation of plasma noise was detected. An rf probe, with which the frequency dependence of the real part of the input impedance of an antenna was detected, was included in one experiment to measure electron density and collision frequency. The data confirm some of the theoretical implications of Balmain's work. The device was designated a real impedance probe. Author

N65-14039# Harvard U., Cambridge, Mass. Cruft Lab.
TABLES FOR CURTAIN ARRAYS Scientific Report No. 4 (Series 3)
Ronald W. P. King, Barbara H. Sandler, and Sheldon S. Sandler
20 May 1964 272 p refs
(Contract AF 19(628)-2406)
(AFCRL-64-674; AD-608336)

The general King–Sandler array theory has been examined in detail for endfire and broadside arrays of up to 35 elements with half- and full-wavelength spacings. Tables of individual admittances, impedances, element currents, and H-plane radiation patterns are presented for endfire and broadside arrays first with driving-point currents specified and then with driving-point voltages specified. Author

N65-14045# New York U., N.Y. Div. of Electromagnetic Research
ASYMPTOTIC THEORY OF WAVE-PROPAGATION
Robert M. Lewis Oct. 1964 108 p refs
(Contract AF 19(628)-4065)
(EMp-200; AFCRL-64-854; AD-609067)

A general method is presented for finding asymptotic solutions of problems in wave propagation. The method is applicable to linear symmetric-hyperbolic partial differential equations and to the integro-differential equations for the electromagnetic field in a dispersive medium. These equations may involve a large parameter λ. In the electromagnetic case λ is a characteristic frequency of the medium. The parameter may also appear in initial data or in the source terms of the equations, in a variety of different ways. This gives rise to a variety of different types of asymptotic solutions. The expansion procedure is a ray method, i.e., all the functions that appear in the expansion satisfy ordinary differential equations along certain space–time curves called rays. In general, these rays do not lie on characteristic surfaces, but may, e.g., fill out the interior of a characteristic hypercone. They are associated with an appropriately defined group velocity. Author

N65-14047# Mitre Corp., Bedford, Mass.
THE PEAK GAIN AND SYSTEM PERFORMANCE OF A LARGE PARABOLOIDAL ANTENNA
B. M. Hadfield, J. B. Suomala, and P. L. Konop Nov. 1964 58 p refs
(Contract AF 19(628)-2390)
(ESD-TDR-64-132; TM03598/0000/01/0/00; AD-608832)

The characteristics that affect the practical operating gain of parabolic reflector-type antennas are discussed, not for design considerations, but to analyze for the systems engineer some of the factors involved in estimating practical performance under arbitrarily set conditions. The effects of structural design, mechanical tolerances and deformations, illumination, and other considerations on the gain of large antennas operating at relatively high frequencies are examined, using theory, graphic data, and an analysis of a typical case using a conventional 60-ft telemetry antenna as an example. The possible system performance degradation resulting from the use of existing large antennas in the new 2200- to 2300-Mc telemetry band is discussed. Author

N65-14049# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADAR Quarterly Progress Report, 1 Jun.–31 Aug. 1964
J. Freedman 8 Oct. 1964 21 p ref
(Contract AF 19(628)-500)
(ESD-TDR-64-373; AD-607160)

Haystack instrumentation for radar signal processing and the Haystack Hill transmitter equipment are described, and work on them during the quarter is reported. Sets of 900-Mc/sec test array antenna patterns were taken, and a computer program for the performance of phaser configurations was written. Other subjects discussed include the S-band subarray; mutual coupling studies; multiple-beam-forming studies; radioastronomical observations; atmospheric studies, and pointing studies with millimeter-wavelength systems; Haystack Hill microwave components; the surface resistivity of microwave components; and solid-state amplifiers of several types. D.E.W.

N65-14055# Illinois U., Urbana. Electrical Engineering Research Lab.
RESEARCH STUDIES ON PROBLEMS RELATED TO ANTENNAS Quarterly Report, 1 Mar.–31 May 1964
James Rippin Oct. 1964 74 p refs
(Contract AF 33(657)-10474)
(QR-7; AD-608261)

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N65-14060# Illinois U., Urbana. Antenna Lab.
RADIATION FROM CIRCULAR WAVEGUIDES
Frank Fellinger Nov. 1964 55 p refs
(Contract AF 33(657)-10474)
(TR-83; AD-608320)

A simple aperture theory is developed and applied to the problem of radiation from a circular waveguide. First, the waveguide is considered to be in free space, and then in an infinite ground plane. The first approach is used to verify the developed aperture theory. Data on theoretical and experimental radiation patterns are presented. Author

N65-14062# Illinois U., Urbana. Radiolocation Research Lab.
DISPERSIVE PROPERTY OF PERIODIC SLOT ARRAY AT THE INTERFACE BETWEEN TWO DIELECTRIC MEDIA Technical Report No. 10
Hassan Morshed Oct. 1964 85 p refs
(Contract Nobsr-89229)
(RRL-262; AD-608321)

Dispersion curves for a periodic slot array, of narrow slots, cut in an infinite conducting sheet and placed at the interface between two homogeneous, isotropic, and loss-free dielectrics, are obtained. The length and the separation of the slots in the array, and the permittivity of the two dielectric media are arbitrary. Cases of both surface waves and leaky waves are considered, and the effects of different parameters of the structure on the dispersion diagrams are studied. Author

N65-14129# Technische Hochschule München (W. Germany). Elektrophysikalisches Inst.
ELF INVESTIGATIONS Final Report No. 1, 1 Apr. 1962–30 Jun. 1964

H. L. König [1964] 37 p refs
(Contract AF 61(052)-603)
(AFCRL-64-759; AD-608668)

Between June 1963 and June 1964 a series of measurements of horizontal magnetic field in the 5- to 15-cps frequency range were performed simultaneously, on 23 different dates, at two locations separated in the east–west direction by approximately 3750 miles. The stations are located near Kingston, R.I., on the American east coast and in Brannenburg, Germany. A consideration of system time delays and possible differences in propagation path lengths indicates that if waveforms recorded at both locations come from the same source they should appear within one-tenth of a second on both records. Three-minute recordings on paper tape running at 25 mm/second were obtained for a total of approximately 160 minutes. On 5 of the 23 days a total of 10 cases were noted where waveforms began within 0.1 second of each other at both stations. Considering individually each 3-minute recording on which simultaneity was observed statistical analysis was performed that takes into account the total number of waveforms above a certain threshold level during each recording period. The results of this analysis show that the number of simultaneously received signals is too large for purely accidental coincidence, and it is concluded that these signals have most likely originated from the same source. Author

N65-14168# Library of Congress, Washington, D.C. Aerospace Technology Div.
COMMUNICATIONS NETWORKS. PART I: REVIEW OF SOVIET LITERATURE, COMPILATION OF ABSTRACTS
6 Nov. 1964 59 p refs *Its* Rept.-4
(ATD-P-64-59)

The abstracts presented are from papers dealing with communications equipment and communications facilities and their location. Among the systems and subjects included are the following: transistorized telegraph equipment; telecommunications; radio relays for railroads; dial exchanges; amplifiers and transceivers; railroad telephone equipment; rural switchboards; table-type telephones; frequency-modulated carrier telegraph systems; and radio relay stations. P.V.E.

N65-14188# Space-General Corp., El Monte, Calif.
THEORETICAL STUDY, SHIPBOARD DIRECTION FINDING ANTENNA ARRAY Final Report
24 Jan. 1964 84 p refs
(Contract N123-(953)33769A)
(SGC-393R-5; AD-603654)

Self-focusing, wide aperture, linear antenna arrays are feasible as shipboard direction finders and have decided advantages over narrow aperture systems. A self-focusing or adaptive wide aperture system has an additional advantage in that it has a memory capability. Multiple sources were shown to be resolvable by a self-focusing, wide aperture antenna system in contradistinction to ordinary narrow aperture direction finders which give erroneous bearings when multiple sources are present. A linear array was empirically found to resolve a number of sources greater than one-fourth, but less than, or approximately equal to, one-third the number of elemental antennas in the array. D.E.W.

N65-14193# Cutler-Hammer, Inc., Deer Park, N.Y. Airborne Instruments Lab.
RADAR DATA MEASURING SYSTEM Final Report
Sep. 1964 80 p
(Contract FA-WA-4206)
(RD-64-126)

This system operates in conjunction with search radars, and continuously makes and records signal energy measurements while automatically tracking a selected aircraft. The system contains three identical measuring channels that measure the ratio of total integrated signal energy to average system noise level; it also contains a fourth signal measuring channel that makes pulse-to-pulse peak amplitude measurements. The four channels operate in parallel on a single selected aircraft. It is concluded that the Radar Data Measuring System fulfills its intended use, and that the signal measurements are an accurate measure of the aircraft signal energy returns. The system has been tested on three different radars and has performed satisfactorily with all three. Author

N65-14197# National Bureau of Standards, Washington, D.C.
A STUDY OF LUNAR SURFACE RADIO COMMUNICATION
L. E. Vogler 14 Sep. 1964 126 p refs
(NBS-Monograph-85) GPO: $0.70

The problem of point-to-point radio communication on the moon is discussed, and equations and curves are presented to estimate power requirements in lunar communication systems. Assuming a smooth surface, consideration is given to ground wave attenuation over both layered and nonlayered grounds, antenna ground losses in situations where ground screens are impractical, noise level estimates in the receiving system, and the effects on propagation of possible lunar ionospheres. An example of the calculation of required power for a particular communication system is given. Author

N65-14204# Continental Electronics Systems, Inc., Dallas, Tex.
AN/FPA-22 (XW-1) AND AN/FPA-23 (XW-1), L/UHF-BAND PENCIL BEAM RADARS Final Report
Johnnie M. Stotts Griffiss AFB, N.Y., RADC, Oct. 1964 74 p
(Contract AF 30(602)-2819)
(RADC-TDR-64-336; AD-609633)

Two L/uhf-band dual pencil beam radar systems, designated AN/FPA-22(XW-1) and AN/FPA-23(XW-1), were developed and placed into operation on the White Sands Missile Range, New Mexico. The primary purpose of these radars is to gather data on radar signatures of targets under the Athena Program. The L-band operates at 1200 to 1311 Mc, while the uhf-band operates at 425 Mc ±5%. Instrumentation recording equipment is contained for acquiring permanent records as noted on oscilioscopes of target signatures. Correlation of the recordings with other missile range events is provided. Each radar installation is complete with dual frequency transmitter, dual frequency receiver, antenna, range interface equipment, and instrumentation recording equipment. The radars are not self-tracking but must be directed to the desired target by signals from other missile range radars or computers. Manual control of the antenna is also available. Author

N65-14207# Stanford U., Calif. Systems Techniques Lab.
A STUDY OF SEVERAL MICROWAVE COMPRESSION FILTER TECHNIQUES Final Report
H. S. Hewitt, W. R. Kincheloe, Jr., and M. H. Musser Griffiss AFB, N.Y., RADC, Nov. 1964 72 p refs
(Contract AF 30(602)-2985)
(RADC-TDR-64-398; AD-609231)

This report describes the design, construction, and performance of several compression filters intended for use in a particular scanning receiver. These filters were designed to

compress pulses in which the frequency varies linearly with time between 1 and 2 Gc, nominally at a rate of 2×10^{16} cps^2 (20 Mc/sec/nsec). Included in the discussion are the following filter types: dispersive helix, folded-tape meander line, printed-circuit meander line, tapped delay line, and radiation-coupled tapered meander line. Author

N65-14292# Martin Co., Orlando, Fla.
RESEARCH STUDY FOR ELECTRONICALLY-STEERABLE GROUND-BASED ANTENNA SYSTEM Final Report, 1 Jul. 1963–1 Jul. 1964
G. P. Kefalas, J. L. Connors, and A. A. Segal Oct. 1964 148 p refs *Its* Rept.-4
(Contract DA-36-039-AMC-02368(E))
(OR-6114; AD-449923)

The specific design of recommended ground terminals, employing a promising array technique in a unique manner, is described in detail. This design evolved from a thorough survey and evaluation of electronic beam-forming and beam-steering techniques and the characteristic limitations of components required to implement them. The design is also based on well-defined requirements and parameters for the overall satellite communications system. Tradeoffs between terminal complexity, portability, and cost vs required gain and number of communication links are given. The phased-array terminal design is feasible and can be implemented with components that are available or well within the state-of-the-art. In contrast to a ground terminal employing parabolic antennas, the recommended array terminal design provides a greater satellite handling (communication link) growth potential and can operate independently of ephemerides on satellite position as a function of time. Hence, the array terminal is readily adaptable to mobile ground or shipborne stations. The array terminal is shown to offer significant advantages over a multiparabola antenna terminal, under conditions of moderate requirements. Author

N65-14296# HRB-Singer, Inc., State College, Pa.
DESIGN AND DEVELOPMENT OF AIRBORNE RADIO INTERFERENCE LOCATOR, PHASE I Final Engineering Report
J. L. Woika, V. H. Ritter, W. R. Chubb, T. W. Collins, R. E. Gawryla et al Sep. 1964 79 p
(Contract FA-WA-4448)
(RD-64-105)

This report describes the engineering effort to develop an airborne system to detect, identify, and locate sources of radio-frequency interference to FAA air navigation aids. Major design decisions are described, and the final feasibility equipment is described in detail. Results of initial test flights are tabulated. The rfi detection and location system is designed to operate over the vor-vhf communications, glide slope, and TACAN frequency bands. Groups of scanning receivers and a display console permit a panoramic display of radio-frequency spectra of the bands of interest. Pairs of direction-finding antennas are included in the system to provide a capability of homing on emitters of undesired signals to obtain their location. This information may be recorded and used by ground vans for later final location. Author

N65-14306# Radio Corp. of America, Princeton, N.J. RCA Labs.
CESIUM VAPOR CATHODE STUDY
A. L. Eichenbaum, F. H. Norman, and H. Sobol Griffiss AFB, N.Y., RADC, Sep. 1964 45 p refs
(Contract AF 30(602)-3241)
(RADC-TDR-64-319; AD-608920)

Stable kilovolt electron beams with current densities up to 800 A/cm^2 were extracted from a cesium-vapor tungsten hollow cathode. A highly directed vapor flow was provided along the cathode surface and away from the electron exit aperture. This permitted the application of extraction voltages from zero to 1.2 kV without gas breakdown or oscillations. Several other tubes are being designed using the directed cesium-vapor feed. Two tubes are being designed for studies of long, magnetically confined beams which are extracted from hollow cathodes. Another tube utilizes cesium feed through an ionizing porous tungsten anode. A silver chloride ring was successfully employed as a demountable seal in a cesium-vapor tube. Author

N65-14369 Stanford U., Calif. Stanford Electronics Labs.
TUNING OF CW LASERS OVER ANGSTROM BANDWIDTHS: SOME POSSIBLE APPROACHES Technical Report No. 0576-6
R. J. Morris Aug. 1964 30p refs
(Contract AF 33(657)-11144)
(SU-SEL-64-092; AL-TDR-64-227; AD-607852)

This report is an investigation of several approaches to the problem of obtaining cw coherent optical signals whose wavelength can be scanned in a controlled fashion over a range of approximately 1 Å or more. The methods discussed include the following internal tuning methods: Zeeman tuning; diffraction from acoustic waves; crystal-strain tuning; thermal tuning; tunable mode selection in wide lines; and doppler-shift tuning using a beam of accelerated particles. The last method listed is believed to be a novel scheme for laser tuning. Frequency modulation using microwave frequencies and large modulation indices is also discussed as an external tuning method. Author

N65-14370# Picatinny Arsenal, Dover, N.J. Ammunition Engineering Directorate
THEORETICAL CALCULATION OF RF ENERGY RECEIVED FROM A TRANSMITTER BY AN ELECTROEXPLOSIVE DEVICE AND COMPUTATION OF SAFE SEPARATION DISTANCES
Dusan Georgevich Oct. 1964 19p refs
(TM-1326; AD-450567)

The objective of this report is to analyze the relationships between the energy emitted by radio-frequency (RF) transmitters, that which is received by electroexplosive device (EED) lead wires, and the proportion of the energy which might reach the bridgewire of an EED. Author

N65-14396# Navy Electronics Lab., San Diego, Calif.
RADIO REFRACTION BY THE MARINE LAYER AND ITS EFFECT ON MICROWAVE PROPAGATION
E. E. Gossard 21 Sep. 1964 11 p refs
(NEL-1240; AD-451653)

The microwave propagation phenomena that exist at the air–sea interface due to the large gradients of temperature and humidity near the sea surface are reported. The parameters that are used to describe radio refractive index are first discussed, and their dependence on temperature and humidity is described. Some refractive index models within the atmospheric boundary layer are discussed, and the effects of surface roughness and atmospheric thermal stability on the models are described. The radio propagation problem is then solved for one kind of model, and a trapping criterion is developed. The theoretical predictions are then compared with experimental data obtained over Cardigan Bay in England and over the Baltic

Sea, by West German workers. It is concluded that meteorological and oceanographic conditions near the air-sea interface can have an important influence on the signal strength and fading characteristics observed on any near-grazing path, if one or both terminals are near the surface of the sea. Author

N65-14445 Litton Systems Inc., Silver Spring, Md. Emertron Information and Control Div.
VHF VEHICULAR CONTOUR ANTENNA Final Report, 15 Jun. 1963–31 Jan. 1964
Frank X. Linder and John W. Hall 17 Jul. 1962 61 p
(Contract DA-36-039-AMC-03188(E))
(FR-1-20012; AD-449717)

The purpose of this study was to design and develop omnidirectional antennas to transmit and receive over a 30 to 76 Mc/sec frequency range when mounted on military vehicles. The following antenna configurations were considered: slotted blade, circular blade, slotted blade with the capacitance distributed along the slot, trombone-type blade, adjustable coil blade, and adjustable circular blade. The final design was a modification of the adjustable circular blade antenna. E.K.R.

08 COMPUTERS

Includes computer operation and programming; and dat processing. For basic research see: 19 Mathematics.

N65-13498# Philco Corp., Palo Alto, Calif. Western Development Labs.
MULTIPLE SATELLITE AUGMENTATION PROGRAM, TRACKING STATION COMPUTER OPERATIONAL PROGRAMS (MILESTONES 2 AND 3)
28 Feb. 1963 49 p
(Contract AF 04(695)-177)
(WDL-TR1931, Rev. 1; AD-297411)

This report describes data processing subsystem operational computer programs to be used at remote tracking sites in support of satellite acquisition, tracking, commanding, telemetry, and station control operations as required. Author

N65-13853# College of Aeronautics, Cranfield (Gt. Brit.)
AN ANALOGUE COMPUTER WITH ITERATIVE COMPUTING FACILITIES
R. J. A. Paul, J. E. Fisher, H. B. Gatland, and A. J. Martin Aug. 1964 58 p refs
(CoA-E&C-2)

A description is given of a new electronic analog computer. The purpose of the machine is to investigate the possible applications of an analog computer which is capable of performing iterative calculations. A few examples of application are included to illustrate the scope of such a facility. The iterative operation is obtained by adopting asynchronous mode control of integrators instead of the conventional synchronous control. A further feature of the new machine is the incorporation of generalized computing units described previously. Author

N65-13855# Oak Ridge National Lab., Tenn. Chemistry Div.
A COMPUTER PROGRAM FOR CALCULATING OSMOTIC AND ACTIVITY COEFFICIENTS FROM ISOPIESTIC DATA
M. H. Lietzke Dec. 1964 28 p refs
(Contract W-7405-ENG-26)
(ORNL-3720) OTS: $2.00

A computer program has been written to calculate osmotic and activity coefficients from isopiestic data. Input to the program consists of the isopiestic molalities of the reference salt and of the substance under investigation. Output consists of the parameters of fit for the substance under investigation, the standard errors in the parameters, and a table of osmotic and activity coefficients computed for an arbitrary list of concentrations. The program is general (for aqueous solutions) and can be used for any electrolyte type at any temperature. A listing of the program is given. Author

N65-13982# Union Carbide Nuclear Co., Oak Ridge, Tenn. Operations Analysis Div.
CRITICAL PATH SCHEDULING WITH RESOURCE LEVELING ON THE IBM-7090
W. A. Gray and E. M. Kidd 20 Mar. 1964 68 p refs
(Contract W-7405-ENG-26)
(K-1499) OTS: $1.50

This report contains a description of a program written to do the computation required in the application of the critical-path scheduling method. The basic critical-path parameters, a network expansion, a resource leveling feature, and the types of output are described. Author

N65-14008# Braddock, Dunn and McDonald, Inc., El Paso, Tex.
DOVE DATA STORAGE AND RETRIEVAL SYSTEM Final Report
Daniel F. Mc Donald, James D. Freeman, Carlos B. Uzeta, and John Dove (RADC) Griffiss AFB, N.Y., RADC, Oct. 1964 24 p
(Contract AF 30(602)-3192)
(RADC-TDR-64-307; DU-6345; AD-608923)

This electronic system makes possible high-speed and high-density storage (and subsequent retrieval) of digital information on recording media such as thin metallic foils or semiconductor films. The heart of the system is an electron beam tube which produces a spot size of five microns at the recording surface by magnetically focusing the beam. Electrostatic deflection is employed to position the beam wherever required. High-speed accessibility for readout operations can be accomplished by special circuitry. The device is a rugged and completely demountable unit. Author

N65-14048# Mitre Corp., Bedford, Mass.
THE COLINGO SYSTEM DESIGN PHILOSOPHY
J. F. Spitzer, J. G. Robertson, and D. H. Neuse Nov. 1964 48 p refs
(Contract AF 19(628)-2390)
(SR-126; ESD-TDR-64-159; AD-608833)

This report describes the design and operation of COLINGO (Compile On-Line and GO), a program system embodying a computer control and query language that provides the operator with a grammar and vocabulary approximating English to control program data and equipment in a data processing system. COLINGO provides both logical and mathematical control of data in the system, and allows the operator to specify the output format and content. It provides the capability of on-line programing in a higher ordered language called

the COLINGO Control Language (CCL). The system provides internal editing, detection, and error correction features. A primary objective was to make COLINGO adaptable to a changing set of requirements and particularly responsive to data compatibility, on-line programing, simple extension, and good man–machine interface. This necessitated maintaining independence of data from programs so that changes in one do not affect the other. The objective was achieved by means of a common retrieval and control program that uses a set of dictionary tables as the translation medium between programs and data. Changes in programs or data are reflected in modifications to the tables instead of the usual modification to the data or programs, or both. Author

N65-14050# Mitre Corp., Bedford, Mass.
USER'S MANUAL FOR THE COMPUTERIZED ELECTRONIC SYSTEM COST MODEL
T. J. Jannsen, H. Glazer, and J. C. Des Roches Oct. 1964 133 p refs
(Contract AF 19(628)-2390)
(ESD-TDR-63-446; TM-03651; AD-608057)

This document describes the initial version of a computerized electronic system cost model and gives instructions for the electronic data processing procedures, including presentation of the key punch input forms, computer output formats, and a description of the computer program logic. The model, currently operational, was programed for the IBM 7090 computer, and requires a 32768 register core memory. The objectives of this manual are to provide a primer for the cost analyst, and a reference manual for the detailed operations on the use of the model. Author

N65-14076# Massachusetts Inst. of Tech., Cambridge.
OPL-1: AN OPEN ENDED PROGRAMMING SYSTEM WITHIN CTSS
J. Weizenbaum 30 Apr. 1964 12 p refs
(Contract Nonr-4102(01); Proj. Mac)
(MAC-TR-7; AD-604680)

The OPL-I, an incremental programing system presently operating with CTSS, permits the user to augment both the program and the data base during widely separated successive sessions at his terminal. Facilities are provided which make it possible for the user to operate on an already established data base both by means of built-in operators and in terms of operators (functions) which the user has previously defined in the language of the system. Underlying the system is a powerful list processing scheme imbedded in FORTRAN (SLIP). The machinery of this fundamental language drives the system and is also largely available to the user. The data base generated by the user is therefore a set of list structures (trees), and most of the operators available are list processing operators. Data structures with considerably complex interrelational properties may therefore be treated quite directly. Author

N65-14128# Computer Associates, Inc., Wakefield, Mass.
AMBIT: A PROGRAMMING LANGUAGE FOR ALGEBRAIC SYMBOL MANIPULATION Scientific Report No. 4
Carlos Christensen 15 Oct. 1964 50 p refs
(Contracts AF 19(628)-419; AF 30(602)-3342)
(AFCRL-64-909; AD-608894)

This paper defines a programing language system called AMBIT (Algebraic Manipulation By Identity Translation). The AMBIT language is intended for the precise description of the operations of mathematics in general, and programs in the languages are suitable for efficient compilation and execution by an automatic computer. The language is distinguished by its adherence to an important portion of the conventional notation of algebra, the "identity". The AMBIT uses the "identity" to express in a single linguistic structure an arbitrarily complex sequence of elementary symbol-manipulation operations, just as FORTRAN and ALGOL use the "formula" to express in a single linguistic structure an arbitrarily complex sequence of arithmetic operations. Thus AMBIT attempts to serve algebra as FORTRAN and ALGOL serve arithmetic. Author

N65-14150# Northrop Corp., Hawthorne, Calif. Norair Div.
NUMERICAL METHODS AND FORTRAN PROGRAM FOR FLOW FIELD CALCULATIONS IN SUPERSONIC CASCADES
J. Der, Jr. and B. N. Mullings Wright-Patterson AFB, Ohio, ARL Oct. 1964 229 p refs
(Contract AF 33(657)-8851)
(ARL-64-146; AD-609013)

This report describes methods and an IBM FORTRAN II program for the calculation of internal viscous and inviscid flow fields within the channels of a supersonic cascade. Methods included are: (1) a second-order Belotserkovskii procedure for calculating the flow field around the forward part of blunt blades; (2) a general method of characteristics procedure for calculating supersonic flow fields; (3) automatic procedures for calculating interactions of shocks of the same and opposite families, shock interactions with a wall and with a vortex sheet or slipstream, and envelope shock formation; and (4) a finite-difference procedure for calculating the laminar boundary layer, which includes a method of suction calculation for maintaining a nonseparated boundary layer under an adverse pressure gradient. Computed results are presented for three sharp-leading-edge channel configurations at $M_\infty = 4.0$. Author

N65-14156# Joint Publications Research Service, Washington, D.C.
THE EFFECTIVENESS OF USING COMPUTERS IN PLANNING
M. Koukolik 4 Jan. 1965 13 p Transl. into ENGLISH from Khim. i Neft. Mashinostr. (Moscow), no. 3, Sep. 1964 p 9–13
(JPRS-28099; TT-65-30038) OTS: $1.00

Various computer programs were formed for the problems of automation processes, shops, plants, and enterprises in the chemical industry. The construction difficulty of automatic control systems increased in proportion to the complexity of the production flow diagram. The computer calculations and manual methods are compared, and the savings in time and expenditures are presented in a profile. It was concluded that calculations requiring expenditures for programing are only economical in the case of frequent and repeated use, because program obsolescence is inevitable after 3 years. A statistical analysis of the use of an electronic computer for design applications in comparison with a manual method showed that the quality of technical solutions increased and that the capital expenditures were lowered. G.G.

N65-14214# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TAPE-DRIVE ASSEMBLY FOR MAGNETIC TAPES IN THE M-2 COMPUTER
V. D. Knyazev and V. N. Sakharov 30 Oct. 1964 17 p Transl. into ENGLISH from a Publ. of the Inst. Elektron. Upravlyayushchnikh Mashin Acad. Nauk (USSR), no. 2, 1962 p 88–97
(FTD-MT-64-231; AD-608077)

Diagrams and detailed operating characteristics are given for the tape-drive assembly which controls the movement of magnetic tape past erase and read–record heads. The components described are (1) the tape-drive mechanism, which assures the sliding of tape under magnetic heads in both directions; (2) a system for winding and unwinding tape from two reels; (3) electronic control circuits to start, stop, and reverse the tape; (4) magnetic erase and read–record heads; (5) a four-cascade-rheostat reading amplifier; (6) electronic control circuits for the reading and recording of information; and (7) a panel for alternative manual control. R.L.K.

N65-14251 European Organization for Nuclear Research, Geneva (Switzerland). Nuclear Physics Div.
ORGANIZATION OF TRIGGERED WIRE SPARK CHAMBERS
F. Krienen 23 Oct. 1964 15 p refs
(CERN-64-44)

The principle of arranging all ferrite cores, regardless of the geometry or size of the spark chambers, in one large matrix with the objective of reaching the shortest word length and the shortest readout time is proposed. The organization of the readout system fulfilling this principle is explained. A distinction is made between homemade wire spark chambers and those requiring a long-term project, with special emphasis on multiton wire spark chambers. Author

N65-14313# Rome Air Development Center, Griffiss AFB, N.Y. Research and Technology Div.
IPC—A CODED CHARACTER SET FOR INFORMATION PROCESSING
Edward Morenoff, John B. Mc Lean, and Lawrence Odell Oct. 1964 18 p refs
(RADC-TDR-64-426; AD-608916)

Information Processing Code (IPC) is an information manipulation-oriented character set and associated binary code representation. The code is designed to simplify internal information-processing operations within the computer, and the character set to maximize the transfer of information between the system user and the system. IPC is an 8-bit code set constructed so that 4-, 5-, 6-, and 7-bit subsets can easily be derived. The set is organized so that simple binary comparisons can distinguish between the numeric, alphabetic, special symbol and control character codes. Unassigned codes are reserved for local interpretation. Author

N65-14372# New York U., N.Y. Courant Inst. of Mathematical Sciences
NU-SPEAK SYSTEM
Judith Glasner, Stanley Ocken, David Rosenberg, Jack Schwartz, George Shapiro et al Nov. 1964 107 p
(Contract AT(30-1)-1480)
(NYO-1480-9)

Nu-Speak is a list processing language embedded in FAP. This manual describes the use of the Nu-Speak system, the use of a corresponding FORTRAN version of the system, and some applications. Author

N65-14466# Northwestern U., Evanston, Ill.
OPTIMIZING STATISTICAL ANALYSIS: DATA SCREENING AND PRECONDITIONING
A. J. Scott Feb. 1964 48 p refs
(Contract Nonr-1228(26))
(TR-7; AD-433551)

This computer program is an outgrowth of a continuing study of computer applications in the earth and environmental sciences, including geology, geography, geophysics, geochemistry, and environmental engineering. The program was prepared to meet a need for methods for handling data containing certain types of sporadic errors that are not accounted for in the statistical model. A common source of error in statistical work arises from misplacement of punches in data cards. It is estimated that the average operator will make punching errors on three cards out of one hundred, and that one of these cards will slip through ordinary editing. This is an example of error from data handling. Another source of error that is common is what may be termed contamination. The present program provides one method for dealing with such errors. Author

N65-14473# Stanford Research Inst., Menlo Park, Calif.
GRAPHICAL DATA PROCESSING RESEARCH STUDY AND EXPERIMENTAL INVESTIGATION Quarterly Progress Report No. 5, 1 Jul.–30 Sep. 1964
A. E. Brain, R. O. Duda, D. J. Hall, and J. H. Munson Oct. 1964 59 p refs
(Contract DA-36-039-AMC-03247(E))
(Rept.-17; AD-453094)

Two groups of tests were run on the SDS 910, simulating the operation of MINOS II. In the first group, the operation of a single-bit output machine (the ninth output bit of MINOS II) was simulated, and it processed a data tape on which MINOS II had previously been trained. Results indicate that the performance of MINOS II is presently comparable with that of a perfect equivalent machine in which a disturbing noise level of 1 percent has been introduced. The second group of tests was concerned with the behavior of MINOS II on the "5-bit parity problem," the standard checkout test. The simulation showed that states in which a cycle recurs endlessly ("trap" states) occur with a frequency comparable to that which is observed experimentally. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-13345# Sperry Rand Research Center, Sudbury, Mass.
A STUDY ON P-N JUNCTION PHOTODETECTORS UTILIZING INTERNAL PARAMETRIC AMPLIFICATION Second Quarterly Report, Period Ending 30 Sep. 1964
David E. Sawyer [1964] 57 p refs
(Contract N600(19)61770)
(SRRC-RR-64-78; AD-450137)

Progress is reported in these areas: (1) device fabrication—die selection techniques, device packaging, and examination of encapsulated devices; (2) device characteristics—diode reverse currents, absolute effective quantum efficiency, Q measurements at 0.7 Gc, and variation of capacitance with voltage; (3) theory—circuit analysis and device considerations for a photoparametric amplifier, and design of edge-illuminated photodetectors. D.S.G.

N65-13346# Turkey. Ministry of National Defence, Ankara. Research and Development Dept.
RC FILTERS EMPLOYING ACTIVE ELEMENTS
Ersin Tulunay [1964] 39 p refs
(RDDR-1)

The generality of an RLC network can be obtained without using coils by the use of active elements to produce negative impedance converters. An active RC filter consists of the combination of two passive RC-type two-terminal-pair networks and a negative impedance converter. The passive networks provide the critical frequencies, while the negative impedance converter connecting the passive networks enables the transfer function of the whole network to have the same generality that the RLC network possesses. It is shown that the use of a negative impedance converter is required to produce a negative impedance if the generality of an RLC network is desired. The disadvantages and advantages of these RC-active element filters are outlined in detail. P.V.E.

N65-13347# Harry Diamond Labs., Washington, D.C.
AN RC TIME CONSTANT MULTIPLYING CIRCUIT
Ronald J. Reyzer 10 Jun. 1964 41 p
(HDL-TR-1234)

A circuit capable of multiplying the RC time constant of a relaxation oscillator has been designed to achieve long periods with small values of R and C. The circuitry required to perform the time multiplication can be packaged in a small volume. In many applications, the extra space required for the circuitry is much smaller than that required for higher value RC combinations of a standard circuit for an equivalent time. The multiplication operation is realized by adding a simple circuit to the basic RC oscillator, using small and stable components. This circuit is an electronic switch that interrupts the capacitor-charging current of the basic RC oscillator in a fixed manner. This fixed interruption, controlled by a few stable components, determines the multiplying factor applied to the basic RC oscillator. This report includes a detailed description of the circuitry and design procedures required to achieve the multiplying operation. Author

N65-13366# Stanford Research Inst., Menlo Park, Calif.
PRELIMINARY FEASIBILITY STUDY OF SUPERCONDUCTIVE NEURISTOR DEVICES Interim Report
D. R. Chambers [1964] 81 p refs
(Contract Nonr-3212(00))
(IR-8; AD-607199)

The superconductive neuristor was developed theoretically from the electrical dual of the thermistor line following the ideas of M. W. Green. An equivalent circuit analysis, based on Green's model, was accomplished, and the necessary conditions for neuristor action are defined in terms of the superconductive phenomena. An experimental study of the propagation of the normal phase along a superconductive filament required the major portion of the effort. The theory of Cherry and Gittleman has been verified for thin film filaments, and certain pertinent extensions obtained. Investigations of the recovery processes have shown that the physical feasibility of the totally distributed neuristor depends on the thermal isolation of the active and passive parts of the structure and is not attainable; however, the operation of a semidistributed neuristor has been demonstrated experimentally, and verifies the basic concepts involved in the original model. The possible employment and subsequent impact of the semidistributed structure on the logic-system philosophy remains to be evaluated. Author

N65-13396# Army Engineer Research and Development Labs., Fort Belvoir, Va.
OXYGEN-CESIUM PHOTOTUBES
A. A. Sokolov [1964] 20 p Transl. into ENGLISH from Elektrichestvo (Moscow), Jun. 1937 p 11-22
(T-1726; AD-606245) OTS: $1.00

Detailed technical data needed for the design of photoelectric instruments is presented on oxygen-cesium phototubes manufactured by Soviet and foreign plants. The characteristics used for comparison include luminous sensitivity, spectral sensitivity, gas amplification, proportionality, dark currents, frequency response, service life, and efficiency. As a result of the comparison, recommendations are made for production of improved phototubes by a Moscow firm. D.S.G.

N65-13562# Systems Engineering Labs., Inc., Fort Lauderdale, Fla.
[AC AND DC MEASUREMENTS FOR A RELAY MULTIPLEXER] Second Quarterly Report
A. G. Randolph 9 Nov. 1964 4 p
(NAS8-11584)
(NASA-CR-59794)

Four relay types were tested and evaluated for use in the relay multiplexer. The ac and dc measurements for the relay multiplexer were split into two groups to provide the greatest amount of reliability and operating flexibility. Since the ac measurements are high-voltage measurements (above 200 volts peak, 150 volts rms), and the settling time is 100 msec for a measurement, the dry-reed-type relays were selected as the most suitable, although their operating speed did not approach the desired 400 samples per second. All dc measurements below 60 volts can use the high-speed Microscan relay which provides the required 400 samples/sec rate. D.S.G.

N65-13910 Joint Publications Research Service, Washington, D.C.
FOCUSSING AND DISPERSING PROPERTIES OF THE FIELD OF A CYLINDRICAL CAPACITOR
I. G. Kozlov and A. S. Shapovalov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 197-209 refs
(See N65-13892 04-07) OTS: $6.00

The possibility determining charged-particle energy from deflection in a nonuniform electrostatic field produced by a cylindrical capacitor is investigated. The basic parameters of charged-particle trajectories in the field, due to a cylindrical capacitor and the particle directional-focusing conditions, are determined. An expression is obtained for the specific energy dispersion in the field of a cylindrical capacitor in which the specific energy dispersion is more than 1.23 times greater than the corresponding quantity in the field of a plane capacitor. Author

N65-13973 General Electric Co., Pittsfield, Mass. High Voltage Lab.
TRANSIENT SYNTHESIZER FEASIBILITY STUDY (PHASE I) Final Report, 5 Jun.-2 Sep. 1964
7 Sep. 1964 62 p refs
(Contract NBy-32262)
(AD-607327) OTS: $3.00

Discussed is a design study to determine the various mechanical and electrical components necessary to build a transient voltage synthesizer. The synthesizer is to provide variations in the frequency and amplitude of a 60-cycle waveform, and to superimpose a 1000-volt spike on the waveform for

testing purposes. The synthesizer will consist of a solid-state SCR inverter, programed by solid-state devices, as the controllable sine wave power source; a surge generator to supply simulated lightning and switching surges; a buffer circuit to protect the power source from the superimposed surges; and suitable instrumentation to indicate and record the pertinent electrical readings. P.V.E.

N65-13985# Sylvania Electric Products, Inc., Waltham, Mass. Sylvania Electronic Systems
ACTIVE THIN FILM TECHNIQUES MICROMIN PROGRAM Final Report, 22 Jun. 1962–1 Sep. 1964
Egons Rasmanis, Rosemary Beatty, and Robert Tiernan 30 Sep. 1964
(Contract NObsr-87633)
(F445-1; AD-607351)

Deposition of device quality silicon films on substrates coated with a mixture of oxides which are fluid at the deposition temperature was investigated. Development of glaze materials in the system $Na_2O \cdot MgO \cdot CaO$ and SiO_2 produced materials for the formation of fluid layers on which both n- and p-type silicon films can be vacuum evaporated. A high vacuum evaporator was designed, built and operated at pressures down to 2×10^{-8} torr. Quality silicon films were deposited at pressures of 10^{-6} torr or better. Hall measurements showed a mobility range of 7 to 60 cm^2/volt-sec at room temperature, and from 13 to 22 cm^2/volt-sec at 77° K. The X-ray and electron diffraction analysis have shown that rheotaxial silicon deposits have a preferred (110) orientation and they consist of aggregates of 2 microns with grains of ~ 3000Å. Annealing of silicon films increased the grain sizes to 200 microns. Doping techniques were developed, and a mask changer was designed making it possible to selectively vacuum deposit silicon films to the geometry and impurity profile necessary to form diodes and transistors. Bipolar transistors were fabricated, and their electrical characteristics are presented. Author

N65-14012# Clevite Corp., Palo Alto, Calif. Shockley Research Lab.
FAILURE MECHANISMS IN SILICON SEMICONDUCTORS
W. Schroen and W. W. Hooper Griffiss AFB, N.Y., RADC, Oct. 1964 74 p refs
(Contract AF 30(602)-3016)
(RADC-TDR-64-361; AD-608456)

This report is divided into two main sections. The first part treats investigations of surface phenomena in oxide-protected silicon devices. The problem of ion motion on oxide layers is studied in considerable detail. The conductivity of oxide layers was measured over extended periods of time. Relaxation effects were observed that are attributed to the motion of ions on the oxide surface under the influence of an electric field. The second part deals with further investigations of second breakdown in silicon power transistors. Transistors were studied which had localized thin spots intentionally introduced into the structure. In all cases, hot spots were formed to occur in all cases at the thin spots. Preparation was begun on simplified transistor structures to study the manner in which hot spots and second breakdown occur, and the role which the base resistance plays in the second breakdown problem. Author

N65-14015# Rome Air Development Center, Griffiss AFB, N.Y. Research and Technology Div.
STUDY OF PART FAILURE MODES Final Report
Lester J. Gubbins Oct. 1964 79 p
(Contracts AF 30(602)-2732; AF 30(602)-2835)
(RADC-TDR-64-377; AD-609056)

Data are presented showing the relative frequency of occurrence of the various failure modes of parts based on field data collected from certain ground electronic equipments and from individual parts tests. The data are compiled on 30 subcategories of parts, the major categories being capacitors, resistors, inductive devices, transistors, diodes, tubes, relays, switches, and connectors. Two examples are given showing how to use the data in making decisions involved with the use of a multiplicity of parts to compensate for some failure modes. A discussion of categorizing failure modes is included. Author

N65-14022# Microwave Associates, Inc., Burlington, Mass.
MILLIMETER WAVE COMPONENT DEVELOPMENT (BEAM-PLASMA AMPLIFIER)
Paul Chorney, Richard J. Madore, and Grant E. St. John Griffiss AFB, N.Y., RADC, Nov. 1964 30 p refs
(Contract AF 30(602)-2948)
(RADC-TDR-64-446; AD-609011)

A summary is given of the plasma testers built to date. Plasma density measurements are described on a plasma tester with small diameter cathodes. The results of an experiment using two Langmuir probes are also discussed. The theory of the PIG discharge is supplemented by studies of the losses, electric field, and the potential distribution in the discharge. The progress to date on the 2-mm BPA study vehicle is outlined, along with a description of modifications to be made. The performance of the waveguide components was improved by several measures, resulting in acceptable values of VSWR and insertion loss. Author

N65-14023# Cutler-Hammer, Inc., Deer Park, N.Y. Airborne Instrument Lab.
MILLIMETER AND SUBMILLIMETER COMPONENT DEVELOPMENT Second Quarterly Report
J. J. Taub, J. Cohen, H. J. Hindin, G. Xurpis, F. R. Arams et al Griffiss AFB, N.Y., RADC, Nov. 1964 55 p refs
(Contract AF 30(602)-3343)
(RADC-TDR-64-468; AD-609090)

Techniques for designing filters, ferrite devices, diode mounts, and radiation detectors in oversize waveguide are being investigated. The filters constructed and evaluated were a 33-Gc four-port dielectric slab filter, a 330-Gc two-port dielectric-slab filter in its low-frequency region, a 33-Gc one- and two-resonator band-pass filter using etched holes in plating on quartz as susceptance elements, and also a 147-Gc band-pass filter using holes in metal plates as susceptance elements. In addition, a 330-Gc four-port dielectric-slab filter structure and an auxiliary 330-Gc two-port dielectric-slab filter structure were constructed. Experiments have continued on Faraday rotation in oversize waveguide. Measurements of ferrite dielectric constants, loss tangents, and mismatches were made. An oversize-waveguide focused diode mount and a saturation mount were constructed and tested. Author

N65-14040# Ford Instrument Co., Long Island City, N.Y. Instrumentation and Special Projects Dept.
RESEARCH STUDIES IN THE ROLE OF ADDITIVES IN THE LOW TEMPERATURE CESIUM DIODE Final Report
L. Haring and G. Grimm Aug. 1964 57 p refs
(Contract AF 19(628)-2983)
(AFCRL-64-722; AD-609047)

Techniques developed previously were refined, which allowed the addition of controlled amounts of Penning mixture (99.9% Ne, 0.1% Ar) to both planar and cylindrical cesium vapor diodes using impregnated tungsten (Philips Type B) emitters in the 1000° to 1200° C range. In the pressure region of 6.5 torr, considerably improved performance resulted in the planar diodes at cesium bulb temperatures between 100° and 150° C. Consideration is given to possible increased barium coverage on the emitter surface, resulting from the additive over pressure, as a mechanism for the enhancement. Author

N65-14064# Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
LOW-LOSS POLYFOAM DIELECTRIC CABLE. PART II: HIGH-FREQUENCY INVESTIGATION
William E. Mayo Jul. 1964 14 p refs
(USAEL-TR-2449; AD-608816)

A low-frequency evaluation of a redesigned commercial-type low-loss polyfoam dielectric cable intended for military application up to frequencies of 100 Mc was reported previously. This work led to further investigation of the redesigned cable up to frequencies of 10000 Mc. This report contains the results of an internal investigation frequencies of 10000 Mc. This report contains the results of an internal investigation into the stability of the electrical characteristics of this cable with respect to exposure to moisture. Author

N65-14072# Radio Corp. of America, Princeton, N.J. RCA Labs.
COMPATIBLE ACTIVE THIN-FILM INTEGRATED STRUCTURES Final Report, Jun. 15, 1963–Aug. 31, 1964
C. W. Mueller, P. H. Robinson, E. P. Helpert et al Nov. 1964 51 p refs
(Contract AF 33(657)-11398)
(AFAL-TR-64-291; AD-609461)

A method was developed for depositing silicon films by the pyrolytic decomposition of SiH_4 on single-crystal sapphire. Insulated-gate field-effect transistors with a transconductance of 1000μmho at 5 mA were made with dimensions of 10μ source-to-drain spacing and an active distance of 120μ. A technique of evaporation was developed in which the source is a large silicon ingot heated by electron beam bombardment. P-type silicon films on sapphire were produced that gave a mobility of 145 cm^2/volt-sec at a concentration of $9 \times 10^{16}/cm^3$. Transistors were formed on small rectangles of silicon so that bonding connections can be made to metal over a sapphire substrate rather than over a thin oxide that may be readily damaged. Intraconnection methods of gold–palladium alloy on sapphire were demonstrated. Resistors of platinum–rhodium alloy were evaporated to a sheet resistance of 2100 ohms per square and coated with Al_2O_3 for protection. Capacitors were made of $La_2Ti_2O_7$ of 1μf/in.^{2} on sapphire. Design parameters for a shift register half-stage incorporating NAND-gate, NOR-gate, and flip-flop circuit action have been determined. Author

N65-14073# National Cash Register Co., Dayton, Ohio. Military Development Dept.
HIGH RESOLUTION RAPIDLY PROGRAMMABLE MASKING FOR FUNCTIONAL ELECTRONIC BLOCKS
Mark Sobottke, Richard Cady, Clifford Kruer et al Nov. 1964 124 p
(Contract AF 33(615)-1158)
(NCR-28-F; AFAL-TR-64-275; AD-609114)

The study and investigation phase of the program included the areas of mask-making requirements, positioning systems, and optical techniques. Mask-making requirements and specifications are defined. Several programable mask-making systems are specified and described. The engineering phase of the program resulted in an economical, programable mask-making system of high resolution. Performance of the present system was checked by processing a series of test tapes and analyzing the results. Author

N65-14080# Hughes Aircraft Co., Los Angeles, Calif. Microwave Tube Div.
APPLIED RESEARCH ON EFFICIENCY IMPROVEMENT IN O-TYPE TRAVELING-WAVE TUBES Interim Engineering Report, 15 Jun.–15 Oct. 1964
O. Sauseng Wright-Patterson AFB, Ohio, AF Systems Eng. Group, Nov. 1964 57 p refs
(Contract AF 33(615)-1951)
(IER-1; AD-608930)

Methods to improve the synchronism of the large signal beam modulation with its circuit wave, of traveling-wave amplifiers are investigated. One approach is to reduce the phase velocity of the circuit near the output end in one or two steps—one and two step velocity taper. The other scheme considered here is to increase the beam velocity by applying a higher voltage to the output section of the circuit (voltage jump). Both methods were analyzed with a one-dimensional large signal digital-computer program for a specific set of tube parameters. A substantial improvement of the efficiency (up to 62% and 66%) is indicated, when the design parameters are optimized. The demountable station was modified to facilitate a quick experimental evaluation of these schemes. The performance of the apparatus was evaluated. The test circuit properties are being determined. Author

N65-14084# Silicon Transistor Corp., Carle Place, N.Y.
PRODUCTION ENGINEERING MEASURE TO INCREASE THE RELIABILITY OF THE TRANSISTOR TYPE 2N2034 Quarterly Progress Report, 1 Jul.–30 Sep. 1964
A. Palmerini [1964] 23 p
(Contract DA-36-039-AMC-01482(E))
(QPR-5; AD-609060)

Improvements were found in the electrical performance of the transistor type 2N2034 as a result of the process improvements. The limits of some of the electrical parameters have been tightened in a proposed military specification of this device. A failure acceleration rate of 12 for every increase of 5-watts dissipation had been found from the results of power stresses at three different levels. This leads to the prediction that the failure rate of 90% confidence would be 0.05% per 1000 hours when the device is subjected to a life test with power dissipation of 2.5 watts at case temperature of 100° C. Author

N65-14087# Advanced Technology Corp., Timonium, Md.
DIODE, MILLIMETER WAVE TYPE MIXER (3.2 mm) Fifth Quarterly Progress Report, 1 Jun.–31 Aug. 1964
R. J. Bauer 30 Sep. 1964 37 p
(Contract DA-36-039-AMC-02347(E))
(Rept.-5; AD-453261)

Insertion loss and VSWR data are presented on a mica window for the integral waveguide-diode mount. Families of curves on conversion loss vs forward bias and LO power are presented for three sealed mixers utilizing the mica windows. The problem on a poor i.f. port VSWR is considered and still

must be resolved. Data on the video detection characteristics of the sealed diodes are presented. Dual trace scope presentations are employed as a means of comparing the diodes' electrical performance vs lifetime. Finally, crystal noise ratio measurements are presented which result in establishing an optimum intermediate frequency to use. Author

N65-14088# Bendix Corp., Davenport, Iowa. Pioneer-Central Div.
FREQUENCY TEMPERATURE COMPENSATION TECHNIQUES FOR QUARTZ CRYSTAL OSCILLATORS Fourth Quarterly Report, 1 Apr.–30 Jun. 1964
3 Aug. 1964 37 p
(Contract DA-36-039-AMC-02282(E))
(Publ.-3051-64; AD-448744)

The use of graphical analysis for TCXO design is discussed. The results of this investigation show that a graphical analysis will not be usable for very accurate compensation because of resolution and parameters that cannot be taken into account with graphs. The techniques for determining compensation networks are discussed. A new technique is described in which diodes are used in conjunction with thermistor–resistor networks. The 5×10^{-8}, Group III TCXO's are discussed. Results of the first compensation attempts are given. The compensation networks and techniques used are presented. Author

N65-14105# Sperry Microwave Electronics Co., Clearwater, Fla.
STUDY OF PULSED RADIATION EFFECTS ON MICROWAVE FERRITE DUPLEXERS Final Report, 1 May 1962–31 Jul. 1964
R. E. Greenwood and G. R. Harrison Aug. 1964 136 p refs
(Contract DA-36-039-SC-89113)
(SJ-222-0041-8; AD-452597)

This report presents the results from a series of five radiation environmental experiments. Included in the report is a description of the equipment and the circuits used to perform the experiments, measurement techniques employed, and a radiation effect per peak gamma dose chart for all devices tested. Photographs of important test setups as well as of oscilloscope presentations are given. The majority of tests were performed under continuous-wave low power (<1.0 W); a limited number of tests were conducted with pulsed high power (5 kW) applied to the devices under study; all power levels were in the 5.4 to 5.9 Gc band. The units tested were coaxial duplexers, waveguide duplexers, coaxial limiters, coaxial circulators, coaxial isolators, waveguide circulators, waveguide adapters, waveguide sections, klystron, magnetron, crystal detector, and various cables and connectors. Author

N65-14158# Joint Publications Research Service, Washington, D.C.
SOME PROPERTIES OF CAPACITANCE INFLUENCE IN IMPULSE CIRCUITS OF A MILLIMICROSECOND RANGE
B. A. Solomin 5 Jan. 1965 7 p Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR, Ser. Tekhn. Nauk (Novosibirsk), no. 6, issue 2, 1964 p 30–33
(JPRS-28116; TT-65-30044) OTS: $1.00

The properties of capacitances introduced into the area of short impulse signals are evaluated. Considered is the charging of a real capacitance which has finite dimensions, as compared to the charging of an ideal condenser which is a mathematical point. It was concluded that capacitors with finite geometry can be considered as transmission lines which have finite retention time and wave resistance. Their behavior is affected by the presence of ferromagnetic matter. G.G.

N65-14169# Library of Congress, Washington, D.C. Aerospace Technology Div.
SPECIFICATIONS OF SOVIET PHOTOMULTIPLIER TUBES. SUMMARY OF DATA
18 Nov. 1964 83 p refs
(ATD-P-64-63)

This is a collection of technical specifications and data for Soviet photomultiplier tubes that are used as experimental equipment for physics research. An appendix contains photographs of various tubes and some charts of their amplitude distribution, sensitivity dependencies, spectral characteristics, etc. G.G.

N65-14203# Electro-Mechanics Co., Austin, Tex.
BRIDGED "T" EXTENSION Final Report
K. S. Garret and R. A. Johnson, ed. Griffiss AFB, N.Y., RADC, Oct. 1964 87 p refs
(Contract AF 30(602)-2969)
(RADC-TDR-64-316; AD-609475)

A series of four tunable rejection networks having attenuations between 80 dB and 100 dB were developed to cover the frequency range of 1 to 10 Gc. Right circular cylindrical cavities with appropriate tuning stubs are used to produce the same electrical characteristics as are found in a lumped parameter Bridged-T network. The main objectives of this study were to develop networks which would permit use on high power systems; have maximum attenuation at the rejection frequency, and low insertion loss at all other frequencies. The principal use of these networks is for the measurement of small spurious signals in the presence of a large carrier signal, for the purpose of electromagnetic compatibility analysis. Various other methods and networks were evaluated during the study, and it was concluded that the resonant cavity devices used in the equivalent Bridged-T configuration were superior. Models have been fabricated and tested, and their performance characteristics are reported together with substantiating theoretical treatment. Author

N65-14205# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
FAILURE MECHANISMS AT METAL-DIELECTRIC INTERFACES
David Peterson Griffiss AFB, N.Y., RADC, Oct. 1964 56 p refs
(Contract AF 30(602)-3266)
(RADC-TDR-64-359; AD-609066)

The interface between a metal and a dielectric is representative of the type of interface found in microelectronic circuitry. Capacitors using thin-film dielectrics were used as a means of studying the changes induced in a metal–dielectric interface by electrical and thermal stress. Thin-film capacitors, which were exposed to 100% R.H. before top electrode evaporation, showed larger changes under stress than similar units which were heated prior to electrode deposition. In general, all capacitors decreased in capacitance, dissipation factor, and T.C.C. after stressing. Thin-film capacitors stressed at 80% R.H. and 40 volts d.c. showed only minor changes in electrical properties. High-temperature stress studies of thin-film capacitors were initiated. Author

N65-14206# Microwave Associates, Inc., Burlington, Mass.
APPLICATION OF SEMI-CONDUCTOR DEVICES TO HIGH POWER DUPLEXERS First Quarterly Technical Report, 1 Apr.–30 Jun. 1964
Paul Basken Griffiss AFB, N.Y., RADC, Oct. 1964 29 p
(Contract AF 30(602)-3278)
(RADC-TDR-64-396; AD-609213)

The basic technical approach is described. A detailed description is presented of a series of experiments to determine the junction temperature behavior of a PIN diode while subjected in the forward biased state to pulsed rf energies. A large portion of the test is devoted to a discussion of the test results. Author

N65-14210# Sperry Gyroscope Co., Great Neck, N.Y. Electronic Tube Div.
WIDEBAND BEAM-TYPE PARAMETRIC AMPLIFIER Final Report, 1 Apr. 1963–31 Jul. 1964
Richard Eng Griffiss AFB, N.Y., RADC, Nov. 1964 69 p refs
(Contract AF 30(602)-3055)
(NA-8210-8364-4; RADC-TDR-64-424; AD-609088)

The objectives of the program were to develop a beam-type parametric amplifier at X-band with a bandwidth of 20 percent, a gain of 25 dB, and a double-channel noise figure of 2 dB. This report covers the experimental study, design, construction, and test of the tube. Using a modified bifilar helix as the coupler circuit and a periodic quadrupole circuit as the pump circuit, an experimental Kompfner dip greater than 20 dB in 6% of the frequency band or 10 dB in 10% of the band was achieved. An electronic gain of 7 dB, with a small variation across the band, was insufficient to overcome the 12-dB loss on the couplers and electron beam. The pump power used was 14 W. Signal and idler frequencies were investigated. The ion-oscillation problem is discussed. Other discussions are concerned with the problems of bifilar helix fabrication, electron gun alinement, and magnetic field shaping. Recommendations for future refinement are made. Author

N65-14212# IIT Research Inst., Chicago, Ill.
STUDY OF COMPREHENSIVE FAILURE THEORY Technical Documentary Report, 28 Feb.–25 Jun. 1964
M. E. Goldberg, F. R. Hand, A. Horberg, H. A. Lauffenburger, D. W. Levinson et al Griffiss AFB, N.Y., RADC, Nov. 1964 104 p refs
(Contract AF 30(602)-3251)
(IITRI-E6006-11; RADC-TDR-64-443; AD-609411)

Studies of failure mechanisms in metal film resistors are reported. Oxidation and precipitation are the principal first-order mechanisms responsible for changes in resistance with time and temperature. It is shown that the γ' phase (Ni_3Al structure) precipitates in the thin films studied in a metallurgically consistent way. Oxidation consists of particulate growth, with some evidence that film growth also occurs. Kinetics for the different processes appear to be distinctly different, with a region of essentially no change appearing to correspond to uniform oxidation growth. The processes investigated have been applied to the mathematical model of resistor behavior. The basic model is in revision to account for such factors as nonuniform film thickness, plaque oxidation, etc. Approximations to account for these processes are presented. Author

N65-14215# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SEMICONDUCTOR VOLTAGE STABILIZERS
A. I. Il'yenkov, I. F. Klistorin, and V. S. Sobolev 1 Oct. 1964 57 p refs Transl. into ENGLISH of the book "Poluprovodnikovyye Stabilizatory Napryazheniya" Novosibirsk, Izd. Sibirsk. Otd. Acad. Nauk SSSR, 1962 p 1–54
(FTD-MT-64-237; AD-608183)

Described are the principle of action, the arrangement, and the basic parameters of semiconductor triodes, stabilizers, and thermistors. Also described are the principles of operation of parametric voltage stabilizers that use silicon stabilitrons and semiconductor thermistors, and of compensational stabilizers using semiconductor triodes. Author

N65-14224# Space Technology Labs., Inc., Redondo Beach, Calif.
HIGH IMPEDANCE ISOLATION TECHNIQUES FOR MONOLITHIC CIRCUITS STRUCTURES Interim Engineering Report, 15 Aug.–30 Nov. 1964
Wright-Patterson AFB, Ohio, AF Avionics Lab., 30 Nov. 1964 42 p ref
(Contract AF 33(615)-1946)
(STL-5280-6001-TU000; AD-452951)

The work resulted in a suitable process for fabrication of monolithic circuits employing dielectric media as electrical isolation from the substrate. Material processing studies are described for silicon etching, silicon oxide deposition, silicon deposition, and surface lap to size. The electrical devices were designed, and the masks were fabricated. Wafer runs are in progress which show important yield advantages for the dielectric isolation method. Author

N65-14252 European Organization for Nuclear Research, Geneva (Switzerland). Accelerator Research Div.
A NANOSECOND PULSE GENERATOR OF 200 kV AMPLITUDE
E. Gygi and F. Schneider 4 Nov. 1964 30 p refs
(CERN-64-46)

The theory and realization of a fast Marx generator are given. A 10-stage type was developed with rise and fall times of 2 nsec. Depending on the load, a peak amplitude of about 200 kV was obtained. The delay between application of the trigger pulse and rise of the output pulse is about 10 nsec with a time jitter of 1 nsec maximum. Due to this small time jitter it is possible to connect several generators in parallel. Author

N65-14263# Northern Electric Co., Ltd., Ottawa (Canada). Research and Development Labs.
A REPORT ON THE COMPUTER DESIGN OF SYNCHRONOUSLY TUNED IF AMPLIFIERS
G. Coverley May 1964 26 p refs
(AD-449942)

One method of evaluating the stability and power gain of four terminal active devices, such as transistors, is to use the chart developed by Prof. Linvill. This report presents a computer program that facilitates plotting of Linvill's charts. The design of synchronously tuned i.f. amplifiers based on the Linvill chart is presented using a computer approach. Experimental results are included. Author

N65-14266 Hughes Aircraft Co., Oceanside, Calif. Vacuum Tube Products Div.
RESEARCH AND DEVELOPMENT OF TWO-COLOR DIRECT VIEW STORAGE TUBE WITH SELECTIVE ERASURE Interim Development Report, 1 Apr.–1 Jul. 1964
P. P. Damon Aug. 1964 10 ref
(Contract NObsr-89452)
(AD-605563)

A direct view storage tube is being developed capable of displaying stored information in either of two colors or in intermediate hues, and selectively erasing that information. The

operating principle is based on the fact that flood electrons, which pass through holes in the storage mask when the storage-surface potential is near cutoff, fall within small areas on the viewing screen opposite the storage mask holes; whereas flood electrons which pass through the holes when the potential is near its maximum, (i.e., flood gun-cathode potential) fall on larger overlapping areas of the viewing screen. The viewing screen consists of two phosphors. One occupies small areas in register with the storage-mask holes, while the other occupies areas surrounding the first. Author

N65-14274# National Co., Inc., Malden, Mass.
PRODUCTION ENGINEERING MEASURE FOR CESIUM BEAM TUBES Quarterly Progress Report, 23 Nov. 1963–23 Feb. 1964
James George [1964] 32 p
(Contract DA-36-039-AMC-01457)
(QPR-3; AD-607967)

Production engineering measures for a general purpose cesium beam tube are defined and broken down into component tasks. The tasks performed involved the fabrication, assembly, alignment, and testing of the second two (PEM-E3 and PEM-E4) of six engineering-model cesium-beam tubes. Preliminary performance data are presented on frequency accuracy and stability as evaluated in an NC1601 Atomichron, with an NC2001 Atomichron used for comparison. The static test data for tubes PEM-E3 and PEM-E4 are presented and compared to that for tubes PEM-E1 and PEM-E2, in order to evaluate design performance. Graphs of various tube parameters are included. The continuation of the reliability and quality-control program and the initiation of the quality-control manual are described. Author

N65-14310# Microwave Associates, Inc., Burlington, Mass.
MAGNETICALLY CONTROLLED GAS DUPLEXER Final Report, 27 Feb. 1963–27 May 1964
Charles S. Ward Griffiss AFB, N.Y., RADC, Oct. 1964 60 p refs
(Contract AF 30(602)-2960)
(RADC-TDR-64-364; AD-608898)

An investigation is described leading to the development of a high power microwave gas duplexer utilizing a fixed external magnetic field to improve switching efficiency within the limit of a specified recovery time. The magnetic field is transverse, i.e., perpendicular to both the microwave electric field and the narrow waveguide sidewalls, and parallel to the axis of the discharge tube. It is shown that under appropriate conditions such a field simultaneously produces substantial reductions in both recovery time and discharge arc loss. A prototype duplexer utilizing this effect and designed to operate at 50 MW peak 100 KW average in S-band is described. Author

N65-14378# SFD Labs., Inc., Union, N.J.
DEVELOPMENT OF AN X-BAND CW CROSSED-FIELD AMPLIFIER Fifth Interim Development Report, 1 Jul.–30 Sep. 1964
W. Zettler Sep. 1964 23 p
(Contract NObsr-89503)
(SFD-33-IDR-5; AD-607861) OTS: $2.00

Successful operation with the reactively loaded interdigital line proved more difficult at X-band than at lower frequencies. The fourth-order periodicity of the structures, together with the small mechanical dimensions which magnify the effects of tolerances, makes it extremely difficult to obtain a good impedance match. In the absence of a good match, the several hot tubes evidenced very strong oscillations at the band edges, with no sign of amplification. Work was begun on a new type of slow wave structure, one that is also a fundamental forward wave circuit but has certain electrical and physical features that make a broadband match relatively straightforward. Hot tubes with this new circuit are under construction. Author

N65-14391# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
ELECTRONIC COUPLING AND CIRCUIT ISOLATION USING AN ELECTRO-OPTICAL DEVICE
Neal H. Phelps, Jr. (M.S. Thesis) Aug. 1964 63 p refs
(GE/EE/64-15; AD-607485)

A load-sensitive LC oscillator is designed and constructed to demonstrate the effectiveness of a photon-coupled-pair (PCP), operating as a photon-coupled isolation amplifier (PCIA), in coupling a signal from the tank of the oscillator. Loading effects on the output of the oscillator are compared for both PCIA and capacitive methods of coupling. Results show that the PCIA provides complete isolation between load and oscillator for load resistance as low as 10 kilohm. In contrast, loading through capacitive coupling disabled the oscillator at a load value of 560 kilohm. The use of the PCIA to isolate the load resulted in improvement of the oscillator frequency stability from a deviation of one part in 500 to one part in 100 000. Frequency response, distortion, and input–output characteristic curves are presented, along with an equivalent circuit, to assist in characterizing a typical PCP, and to provide tools necessary to explain the operation, limiting features, and isolation advantages of a PCP when it is used as an electronic signal coupler. Author

N65-14393# Illinois U., Urbana. Radiolocation Research Lab.
A RAPID RESPONSE DIODE SWITCH FOR LOW LEVEL SIGNALS IN THE H.F. BAND Technical Report No. 24 and Technical Report No. 8
Albert Marinus Schaffer Sep. 1964 59 p refs
(Contracts Nonr-1834(02); NObsr-89229)
(RRL-260; AD-607471) OTS: $3.00

Design requirements are outlined for a diode switch featuring low insertion loss and high isolation in the range 2 to 32 Mc/sec. Circuit models are presented using diodes in series, shunt, and series–shunt switching configurations. On the basis of the characteristics predicted for the models, a switch configuration is considered which could be expected to fulfill the design requirements. The measurement apparatus and technique are described, and experimental results are examined. Differences between measured and calculated switch characteristics are discussed, and methods for improving its performance are suggested. Author

N65-14414# Texas Instruments, Inc., Dallas.
DEVELOPMENT OF GALLIUM ARSENIDE-PHOSPHIDE GRADED BAND-GAP BASE TRANSISTOR STRUCTURES First Interim Engineering Report, 23 Jun.–23 Sep. 1964
R. W. Haisty, L. G. Bailey, and R. C. Sangster 20 Oct. 1964 37 p refs
(Contract NObsr-91238)
(TI-08-64-154; AD-450398)

A system for epitaxial deposition of Ga(As,P) was built and tested. Good epitaxial deposits of GaAs were readily obtained with this equipment. Deposits of $GaAs_xP_{(1-x)}$ ranging from (1-x) = 0 to 0.8 were produced. Deposits with (1-x)

greater than 0.4 were not adherent when put directly on GaAs substrates; however, adherent deposits over the entire composition range can be obtained by grading the deposits. Effects of seed temperature and As/P ratio on the composition and quality of the deposits were investigated. Theoretical analysis of the GBGB structure was carried out to determine how doping profile, rate of change of band-gap, and variation of mobility across the base region affect ultimate device performance. A specific geometry was chosen, and curves of resulting device performance are presented. Author

N65-14415# Sperry Gyroscope Co., Great Neck, N.Y. Electronic Tube Div.
DEVELOPMENT OF AN ELECTRON BEAM DUPLEXER Final Report, 15 Mar. 1963 – 14 Mar. 1964
B. Kleinman and J. Knapp Jun. 1964 60 p
(Contract DA-36-039-AMC-02174(E))
(NA-8210-8352-4; AD-450597)

This report describes the program for the research and development of an electron beam duplexer having specified characteristics. A functional description of the device points out the manner of coupling transmitter to antenna to receiver, making use of two helical slow wave circuits and the beam fast space-charge wave. When parameters are properly chosen (Kompfner dip length, propagation constants, etc.), complete energy transfer between input signal and beam occurs while the input noise is stripped away. The equations describing the feasibility of this transfer are given. Author

N65-14458*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF TRANSISTORS AND DIODES FOR MICROPOWER CIRCUIT APPLICATIONS
John C. Sturman and Donald G. Kovach Washington, NASA, Jan. 1965 43 p refs
(NASA-TM-X-1050) OTS: HC $2.00/MF $0.50

Semiconductor devices suitable for use at power levels below 1 mW per stage have been difficult to obtain and are not usually characterized for use at sufficiently low levels of current. This report presents low-level parameters for a number of transistors and diodes as a guide to selection in adequate detail for most circuit design. The data presented were used to characterize transistors for logical switching circuits; however, the data can be applied equally well to the selection of devices for micropower linear applications. These data should be of use to anyone attempting to design circuitry operating at power levels less than 1 mW per stage. Author

N65-14472# Watkins-Johnson Co., Palo Alto, Calif. Tube Research and Development Dept.
STUDY OF DISTORTION IN KLYSTRONS AND TRAVELING-WAVE TUBES Fifth Quarterly Progress Report, 1 Jun.–31 Aug. 1964
William Kunz [1964] 27 p
(Contract DA-36-039-AMC-02321(E))
(Rept.-5; AD-452144)

Described is the study of distortion in klystrons and traveling-wave tubes. Experimental results are given for severed-helix and expanded tapered helix versions of the WJ-237, a PPM-focused 2.5 watt L-band traveling-wave tube. These include balanced two-tone intermodulation tests. The phase characteristics of the standard and low-perveance versions of the tube are given. The intermodulation characteristics of the tube types tested thus far are compared. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-13497# Microwave Associates, Inc., Burlington, Mass.
SOLID-STATE S AND X BAND LIMITERS Quarterly Progress Report
Robert Tenenholtz 10 May 1963 19 p
(Contract NObsr-87307)
(QPR-4; AD-405976)

Both S- and X-band limiters utilize a first-stage high-power PIN limiter arrangement, and employ power sharing to achieve desired peak power handling capability. Experimental high-power results are presented for both X- and S-band operation along with preliminary life test data. Performance of a novel dc return required in the S-band limiter is described. Author

N65-13510# Joint Publications Research Service, Washington, D.C.
CONTROL SYSTEM WITH DOUBLING ACTUATING ELEMENTS WITH DRY FRICTION
I. T. Borisenok 31 Dec. 1964 19 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. I: Mat. i Mekhan. (Moscow), no. 3, 1964 p 75–86
(JPRS-28072; TT-65-30028) OTS: $1.00

Stable oscillations and conditions for their existence in an automatic control system with correcting or noncorrecting doubling actuating elements (DAE) were studied. The influence of dry friction and inertia of the actuating elements was considered. The problem with doubling servomechanisms was studied. Author

N65-13524# Technische Hochschule Darmstadt (W Germany).
CYLINDRICAL DIELECTRIC SURFACE WAVEGUIDES AND THEIR STIMULATION BY ELEMENTARY RADIATING SYSTEMS [ZYLINDRISCHE DIELEKTRISCHE OBERFLACHENWELLENLEITER UND IHRE ANREGUNG DURCH ELEMENTARSTRAHLER]
Wolfgang Schlosser (Ph.D. Thesis) [1964] 160 p refs in GERMAN

Mathematical methods are presented for the study of the behavior of surface waves on a dielectric wire, with consideration of small bends and elliptical deformations of the waveguide. The same evaluations were performed for the case of a Harms–Goubau waveguide and a dielectric pipe, and the results are compared. The transmission characteristics of the EH_{11} wave on the Harms–Goubau waveguide were found most suitable for technical applications. A formula was developed for the interference spectrum of a dipole. G.G.

N65-13529# RAND Corp., Santa Monica, Calif.
NEW ANALYTIC AND COMPUTATIONAL METHODS FOR TREATING NONLINEAR CIRCUITS
Richard Bellman Jul. 1963 16 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3719-PR; AD-410833)

Over the last 10 years, a number of new mathematical techniques were developed to treat various classes of nonlinear

problems. In this paper three theories are briefly discussed: invariant imbedding, dynamic programing, and quasi-linearization. A selected list of references is provided. Author

N65-13568# Joint Publications Research Service, Washington, D.C.
CONTROL AND CONFIGURATION OF OPTIMAL ELECTRIC NETWORKS
V. S. Burok 28 Dec. 1964 39 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Elektromekhan. (Novocherkassk), no. 8, 1964 p 958–970, 979–990, 1026–1027 (JPRS-28005; TT-65-30003) OTS: $2.00

CONTENTS:
1. OPTIMAL CONTROL OF THE DRIVE OF A FLYING SAW V. S. Burok p 1–8 refs
2. DETERMINING THE OPTIMAL CONFIGURATION OF AN ELECTRICAL NETWORK A. E. Kazhdan p 9–18 refs
3. CONCERNING THE LIMITATIONS IMPOSED BY OBJECTS ON THE FEASIBILITY OF INVARIANT AND AUTONOMOUS CONDITIONS B. V. Il'in and V. L. Rukin p 19–33 refs
4. AUTOMATIC ELECTRONIC RECORDER WHICH PERFORMS DIVISION OF TWO DIFFERENCES V. Ye. Shukshunov and Ye. I. Fandeyev p 34–36 refs

N65-13834# Joint Publications Research Service, Washington, D.C.
ON THE DYNAMIC CHARACTERISTICS OF REAL STRUCTURES FOR HIGH PRECISION AUTOMATIC REGULATION
V. G. Kagan 5 Jan. 1965 12 p refs Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR, Ser. Tekhn. Nauk (USSR), no. 6, issue 2, 1964 p 39–46
(JPRS-28115; TT-65-30043) OTS: $1.00

An analysis of the generalized structure of a regulating direct current electrodrive gave quantitative relations between the dynamic characteristics exponents and the system parameters. A diagram was obtained that gives a full representation of the structure and establishes a connection of any system parameters with output parameters, and makes it possible to estimate the effects of the various parameters. G.G.

N65-13890# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
ON APPLICATIONS OF BIOLOGICAL PRINCIPLES TO THE DESIGN OF FEEDBACK CONTROL SYSTEMS
J. M. Mendel Nov. 1964 63 p refs
(SM-47772)

The results of a survey revealed that very few biological principles have been applied to the design of control systems. Two notable exceptions, however, are the applications of homeostasis and learning theory, which are discussed in detail. Author

N65-13911 Joint Publications Research Service, Washington, D.C.
ABSOLUTE STABILITY OF A SERVO SYSTEM WITH PLAY
V. A. Brusin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 210–220 refs (See N65-13892 04-07) OTS: $6.00

The sufficient conditions of absolute stability were found for a servosystem with play by the application of Popov's method. Considered are the stability of the equilibrium state for a constant input signal, and its absolute stability when it contains substantial nonlinearity. The effective sufficient conditions for the absolute stability of the system are found on the basis of the frequency characteristics of the linear element and extended to a nonlinear system. G.G.

N65-13912 Joint Publications Research Service, Washington, D.C.
THE LAPLACE TRANSFORM AND THE INVESTIGATION OF TRANSIENT PROCESSES
A. S. Rozenfel'd *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 221–230 refs (See N65-13892 04-07) OTS: $6.00

Changes of the Laplace transform rules in operational methods of studying transient processes are presented. The state of the dynamic system prior to the appearance of a transient is given by formulating the problem and determining the preimage functions. The effects of the elimination of equal zero for negative values of the argument, the elimination of discontinuities of the first kind of preimages, and the change in the lower limit of the Laplace integral were investigated in relation to the operations in the preimage and image domains. A unified, reliable system of rules was constructed that permits the transformation of both ordinary and generalized functions of finite order. An example of the application of the rationalized rules for the Laplace transform is given. G.G.

N65-13960*# Connecticut U., Storrs.
CONTROLLER DESIGN FOR NONLINEAR AND TIME VARYING PLANTS
Richard V. Monopoli Washington, NASA, Jan. 1965 24 p refs
(Grant NsG-309-63)
(NASA-CR-152) OTS: HC $1.00/MF $0.50

A technique for controller design previously reported is generalized to include a wide class of plant nonlinearities. The technique, based on Liapunov's second method, generates a control signal which forces the plant states to be close to the states of a model reference. In addition to the generalization, the technique is extended to include convergence time, i.e. time of response to initial perturbations of the equilibrium, as part of the design problem. Also, modifications to the original technique are made which make it more attractive from an engineering point of view. Author

N65-13967# Technische Hochschule Darmstadt (W. Germany).
DIPOLE WAVE PROPAGATION IN HOLLOW WAVEGUIDES WITH WEIGHTED BOUNDARY [DIPOLERREGTE WELLENFELDER IN HOHLLEITERN MIT BESCHWERTER RANDZONE]
Peter Costantin (Ph.D. Thesis) [1964] 118 p refs In GERMAN

Theoretical analyses of a dielectric hollow waveguide and of a helical waveguide were performed, and their characteristics were compared. Assumed was a dipole excitation of the waveguides and a surface impedance of zero in the formation of the basic equations. Emphasis was placed on the calculations of a damping formula for the HE_{11} wave and the damping ratio of the H_{01} to HE_{11} waves. G.G.

N65-14106*# Control Research Associates, Laurel, Md.
STUDY OF THE DYNAMIC STABILITY AND CONTROL OF LARGE NON-RIGID AEROBALLISTIC VEHICLES, VOLUME II Final Report
Daniel C. Lewis, Pinchas Mendelson, J. Schlesinger, J. Gilchrist, K. Ivey et al [1960] 267 p
(Contract NAS8-5008)
(NASA-CR-60062) OTS: HC $6.00/MF $1.50

CONTENTS:

1. MATHEMATICAL THEORY OF THE TIME OPTIMAL CONTROL PROBLEM D. C. Lewis and Pinchas Mendelson p 2–193 ref (See N65-14107 04-10)

2. SIMULATION AND COMPUTATION J. Schlesinger, J. Gilchrist, K. Ivey, and G. Campbell p 194–259 ref (See N65-14108 04-10)

N65-14107* Control Research Associates, Laurel, Md.
MATHEMATICAL THEORY OF THE TIME OPTIMAL CONTROL PROBLEM
Daniel C. Lewis and Pinchas Mendelson *In its* Study of the Dyn. Stability and Control of Large Non-Rigid Aeroballistic Vehicles, Vol. II [1964] p 2–143 ref (See N65-14106 04-10)

Subjects discussed include the derivation of a closed control law for the system $\ddot{x} = \epsilon$, control laws for systems of arbitrary order and reduction to canonical form, derivation of a control function for the third-order controllable linear system with eigenvalues $0, \lambda, -\lambda$, a control function for controllable linear systems with four zero eigenvalues, the controllable linear system with eigenvalues $0, 0, \lambda, -\lambda$, a new theory of elimination, time optimal control subject to phase coordinate constraints, and a three-dimensional example of bang-bang control with phase coordinate constraints. Parametric equations are given of the three-dimensional switching manifold for the fourth-order linear system with eigenvalues $(0, 0, -\lambda, \lambda)$. D.E.W.

N65-14108* Control Research Associates, Laurel, Md.
SIMULATION AND COMPUTATION
J. Schlesinger, J. Gilchrist, K. Ivey, and G. Campbell *In its* Study of the Dyn. Stability and Control of Large Non-Rigid Aeroballistic Vehicles, Vol. II [1960] p 194–259 ref (See N65-14106 04-10)

Three third-order systems are described by equations, and three methods of simulation and computation are given and discussed. The performance under disturbances was synthesized, and an attempted computer simulation of nonoptimal control of the fourth-order system did not work. Computer programs listed include *Control Law III with Step Noise, Gilchrist Control Law III,* and *Wind Optimal Seeing Eye Control with Help.* D.E.W.

N65-14190# Pittsburgh U., Pa.
NETWORK SYNTHESIS USING RC LINES AS THREE AND FOUR TERMINAL ELEMENTS
Donald Leigh Hirst (M.S. Thesis) 1964 171 p refs
(AD-603475) OTS: $5.00

Certain impedance, admittance, and transfer functions were investigated, and a procedure was developed for synthesizing these functions by using distributed-parameter RC lines. The nature of an RC line network was studied with a resulting symmetrical loop impedance matrix. A transformation was made between this matrix and the homologous matrix for RL networks. A set of necessary and sufficient conditions was stated in a theorem and shown to be necessary and sufficient for the realization of selected impedance functions as a cascade of RC lines. The admittance functions were considered by the partial fraction expansion approach. This technique was also shown to result in a modified cascade structure of RC lines under the conditions mentioned above. It was found that when the transfer admittance was given in a certain form, the function could be realized by a technique utilizing a negative emittance converter. The transient and frequency response characteristics of two hyperbolic functions were calculated with a digital computer, and the results were plotted and tabulated. D.E.W.

N65-14199# Cornell U., Ithaca, N.Y. Electrical Engineering Research Lab.
REVIEW OF A RESEARCH EFFORT IN ACTIVE NETWORK THEORY Interim Report
N. De Claris and S. K. Mitra Wright-Patterson AFB, Ohio, AF Avionics Lab., Aug. 1964 82 p refs
(Contract AF 33(657)-10682)
(AL-TDR-64-180; AD-607081) OTS: $5.00

The work includes tasks directed to the realization of active network functions and the applications of certain algebraic mathematical techniques to network theory. These studies concern transfer function synthesis using tunnel diodes as active elements, synthesis of transfer functions using nonideal negative impedance converters as the active devices, construction of a network function from its specified even (odd) part, driving-point function realization based on a polynomial decomposition approach, and compatibility of impedance matrices of active multiports. Author

N65-14208# Polytechnic Inst. of Brooklyn, N.Y.
RESTRICTIONS ON LINEAR PHASE, LOW-PASS NETWORKS WITH PRESCRIBED PARASITIC LOADS
George I. Zysman and Herbert J. Carlin Griffiss AFB, N.Y., RADC, Nov. 1964 25 p refs
(Contract AF 30(602)-2868)
(PIBMRI-1228-64; RADC-TDR-64-408; AD-609087)

The problem considered is that of a low-pass, linear phase filter operating between a resistive generator and a prescribed load containing parasitic reactances. The presence of the parasitic elements results in a minimum time delay-bandwidth restriction of a signal propagation between the generator and the load. Such a restriction is derived by considering gain-bandwidth integrals for gaussian transfer amplitude filters. For the very important case of unit dc gain, these restrictions are expressed in terms of the Riemann Zeta function. For gains less than unity at dc, the results are in terms of Appel integrals. The loads considered here have all their zeros of transmission at infinity. Author

N65-14211# Illinois U., Urbana. Electrical Engineering Research Lab.
THE REFLECTING BEAM WAVEGUIDE
James E. Degenford Griffiss AFB, N.Y., RADC, Oct. 1964 84 p refs
(Contract AF 30(602)-3046)
(RADC-TDR-64-429; AD-609432)

A type of beam waveguide which uses appropriately shaped metal reflectors instead of dielectric lenses as the phase correcting devices is described. A theory has been developed which, subject to certain restrictions, describes the modes of this type of beam waveguide and predicts a loss of

the order of 0.01 dB per iteration. A reflecting beam waveguide comprising eight aluminum reflectors was investigated at a wavelength of 4 millimeters. The measured loss per iteration, approximately 0.015 dB, is in good agreement with the theoretical value. The cross sectional electric-field distribution was also measured and found in satisfactory agreement with the theory. A convenient and inexpensive technique for constructing the reflectors from commercially available metal foils is described. It is shown that the reflecting beam waveguide is a practical system for the transmission of power at submillimeter wavelengths. Author

N65-14225# Michigan U., Ann Arbor. Electron Physics Lab.
RESEARCH ON CROSSED-FIELD ELECTRON DEVICES Interim Scientific Report No. 4, 1 Mar.–15 Sep. 1964
T. A. De Massa, S. G. Lele, N. A. Masnari, J. E. Rowe, and V. K. Tripathi Oct. 1964 220 p refs
(Contract DA-36-039-AMC-00027(E))
(Rept.-05361-10-S; AD-453639)

The nonlinear M-type interaction investigations resulted in numerous curves illustrating the operating characteristics of both FWA and BWO. The information is useful in the design and evaluation of experimental injected-beam devices. The experimental S-band amplifier investigations indicated small-signal gains of approximately 24 dB for pulsed operation. The performance was evaluated both with uniform and tapered slow-wave circuits. The results of the theoretical study of the gain, efficiency, and power characteristics of crossed-field devices are summarized. The crossed-field noise investigations include both experimental and theoretical work. The performance of the experimental triode is compared with that of the diode. The Monte Carlo technique was applied to the problem of the noise propagation in the abbreviated Kino gun. Author

N65-14271# RAND Corp., Santa Monica, Calif.
SEGMENTAL DIFFERENTIAL APPROXIMATION AND THE "BLACK BOX" PROBLEM
Richard Bellman, Brian Gluss, and Robert Roth Oct. 1964 30 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4269-PR; AD-607460) OTS: $2.00

In previous work on differential approximation, it was assumed that a black box under consideration could be described by a differential equation of a given type with unknown parameters, which are then determined by various optimization methods. In the present memorandum, this approach is extended to the case in which the black box comprises subsystems, each subject to its own differential equation, in which switching occurs. Methods are explored for determining the nature of the subsystems and for estimating the times at which switching occurs, and the subsystems involved. Author

N65-14273# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
QUALITATIVE ANALYSIS OF ONE SYSTEM OF DIFFERENTIAL EQUATIONS PERTAINING TO CONTROL THEORY
N. N. Serebryakova 30 Sep. 1964 28 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 5, 1963 p 29–41
(FTD-TT-64-417/1+2+4; AD-607114) OTS: $2.00

A system for stabilizing the rate of rotation of the shaft of a dc electric motor using a clock regulator with an oscillating balance-spiral system and a contact equalizing device is considered. Piecewise linear differential equations describing this system are investigated by the method of point transformation, and all possible regimes of its operation are found. Author

N65-14314# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
SYNTHESIS OF SEQUENTIAL SWITCHING NETWORKS Final Technical Documentary Report, Jun. 15, 1963–Oct. 14, 1964
A. K. Susskind, D. R. Haring, C. L. Liu, and K. S. Menger Griffiss AFB, N.Y., RADC, Oct. 1964 174 p refs
(Contract AF 33(657)-11677)
(ESL-FR-216; RADC-TDR-64-492; AD-608881)

Topics covered are the synthesis of permutation machines with threshold elements—in particular, one threshold element per memory element; a method of synthesis in which the combinational logic of any sequential circuit may be realized by means of a cascaded arrangement of S-input, S-output logic blocks (S denotes number of state variables). That approach has applicability in integrated circuit realization of computers. Other topics are in the synthesis of sequential switching circuits in shift-register form. Author

N65-14320# Martin Co., Baltimore, Md. RIAS Div.
NONLINEAR SYSTEM ANALYSIS AND SYNTHESIS. PART I: STUDY OF LYAPUNOV FUNCTIONS FOR PROBLEMS OF CONTROL AND OF OPTIMALITY OF LINEAR SYSTEMS
R. E. Kalman, G. P. Szego, and T. S. Englar Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Oct. 1964 168 p refs
(Contract AF 33(657)-8559)
(FDL-TDR-64-58, Pt. 1; AD-608927)

Research involved the following four areas: (1) The Lyapunov function for the problem of Lur'e in automatic control—This problem is resolved by giving conditions for the existence of a Lyapunov function and an algorithm for its construction. (2) The polynomial Lyapunov function—A preliminary study of the use of polynomial Lyapunov functions in the study of stability was made, with particular attention to possible computational utilization. (3) Discussion of the problem of when a linear control system is optimal—Given a control law, for what performance indices is it optimal? Treatment of the problem involves the use of frequency-domain techniques. (4) ASP modifications. Author

N65-14324# Systems Technology, Inc., Inglewood, Calif.
EXTENSION OF LINEAR CONSTANT-COEFFICIENT ANALYSIS METHODS TO TIME-VARYING SYSTEMS Final Report, Mar. 1962–Oct. 1963
Walter A. Johnson, Duane T. Mc Ruer, and Anil V. Phatak Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Sep. 1964 129 p refs
(Contract AF 33(657)-8294)
(RTD-TDR-63-4178; AD-608621)

For system characterization, constant-coefficient concepts are reviewed and their time-varying parallels introduced; kernel functions and system functions are evolved by analogy with their constant-coefficient counterparts—weighting functions and transfer functions. For quantitative response information, a constant-coefficient series technique in which a very few constant-coefficient system responses are summed to approximate the response of a

time-varying system is presented. The technique is a practical procedure for the determination of approximate kernel functions or other system response characteristics. The qualitative response or stability nature of certain time-varying systems is also treated. For some systems identification of asymptotic system characteristics with known Euler or constant-coefficient system solutions allows constant-coefficient stability criteria to be applied to a variety of time-varying-coefficient problems. Several examples are given to illustrate each concept presented. Author

N65-14358# California U., Berkeley. Electronics Research Lab.
REALIZABILITY OF n-PORT RESISTIVE NETWORKS WITH MORE THAN (n + 1) NODES
K. R. Swaminathan and I. T. Frisch 14 Jul. 1964 43 p refs
(Grants AF-AFOSR-139-63; AF-AFOSR-139-64)
(Rept.-64-23; AD-450736)

A new set of necessary conditions are presented for an nth order square symmetric matrix with real entries to be the n-port admittance matrix of a network containing positive resistors and more than (n+1) nodes. Author

N65-14375# Queens U., Kingston (Canada).
APPROXIMATE ZERO-CROSSING DISTRIBUTIONS USING THE TYPE B GRAM-CHARLIER SERIES
Hans Levenbach Aug. 1964 44p refs
(Contract DRB-313002)
(RR-64-2)

The type B series consists of a linear function of the Poisson distribution and its derivatives. The probability $p(n,\tau)$ of exactly n zeros occurring in a given interval $(t, t+\tau)$ of a stationary, random process is expanded in the type B Gram–Charlier series. The expansion is used to derive approximations to the distribution of intervals between zeros. Specific results are presented in the case of gaussian noise for the probability density function $P_0(\tau)$ of successive zero-crossing intervals and for the probability $p(0,\tau)$ that a given interval τ contains exactly zero zero-crossings. The accuracy of the approximations is compared with Rainal's experimental results and with upper and lower bounds presented by Longuet–Higgins; comparisons are most satisfactory where successive zero-crossing intervals are nearly uncorrelated. For narrowband gaussian noise the results are unsatisfactory. Graphs of the mean square number of zeros are given for the cases of gaussian noise considered. Author

N65-14387# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
GENERALIZATION OF NODAL-SHIFT TECHNIQUES TO LOSSLESS n-PORT NETWORKS
John Irving Molinder (M.S. Thesis) Aug. 1964 76 p refs
(GE/EE/64-14; AD-607484) OTS: $3.00

A procedure for generalizing nodal-shift measurements to lossless n-ports is presented. The procedure involves reducing the n-port problem by steps to a series of two-port problems. This provides a method of determining the matched network reflection coefficients. The determination of the scattering matrix for a lossless reciprocal three-port given the matched reflection coefficients is also discussed. The diagonal elements of the scattering matrix are equal to the respective matched reflection coefficients. The magnitudes and angles of the off-diagonal elements may be determined within an angle ambiguity using the orthogonality conditions. Author

N65-14390# Brown U., Providence, R.I. Div. of Engineering
AN ALTERNATE APPROACH TO THE RESOLUTION OF TUNNELING CURRENT STRUCTURE BY DIFFERENTIATION
William R. Patterson and J. Shewchun Oct. 1964 21 p refs
(Contract ARPA E-6)
(AD-450952)

Structure in the current–voltage characteristics of tunneling junctions is revealed by displaying the second derivative of current with respect to voltage (d^2i/dv^2) as a function of junction bias. Equipment for doing this was first described by Thomas and Klein. This paper describes an alternate approach to the recovery of the first and second derivatives using a transistorized electronic circuit which in addition to being compact and rather inexpensive, provides as good, if not better, resolution than that previously reported. The current–voltage characteristic of a typical silicon tunnel diode at 4.2° K and the first and second derivatives of this characteristic using the apparatus described are given. Author

N65-14398# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DYNAMICS OF CONTINUOUS AUTOMATIC OPTIMIZERS FOR ONE CLASS OF SYSTEMS
A. A. Belen'kiy and A. B. Chelyustkin 9 Mar. 1964 23 p refs
Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), v. 24, no. 6, 1963 p 785–798
(FTD-MT-64-34; AD-605601) OTS: $1.00

The use of correlation methods of control offers the possibility of building effective, interference–resistant systems of automatic optimizers, as is shown in the example of the disturbance system with automatic alinement of the parameters of the compensator. Systems of a similar type can be utilized in different areas of technology, such as optimum control by the welding regime of electric pipe-welding machines, and mills regulation of the thickness of strip in cold- and hot-rolling mills. Author

N65-14463# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
ANALOG TECHNIQUES FOR FILTER SIMULATION
Arthur Bridgman 25 Sep. 1964 36 p refs
(Contract DA-36-039-AMC-03404(E))
(EDL-M733; AD-454034)

Techniques are provided for simulating various low- and high-pass filters, based on the filter transfer function. The low-pass–high-pass transformation is used to obtain high-pass filters from the normalized low-pass filters. Frequency scaling is discussed for converting the filter cutoff frequency from the normalized 1 rad-sec to the desired cutoff frequency. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-13495# Vitro Labs., West Orange, N.J.
DEVELOPMENT OF A FLUID TRANSPIRATION ARC RADIATION SOURCE
Edward A. Mayers, Walter A. Jaatinen, Frank R. Sileo et al Arnold AF Sta., Tenn., Arnold Eng. Develop. Center, Nov. 1964 138 p refs
(Contract AF 40(600)-951)
(AEDC-TDR-64-251; AD-451787)

Component development and system design studies were carried out culminating in construction of a breadboard fluid transpiration arc (FTA) source, including a gas recirculation loop. All components of this source operated satisfactorily at 25 kW during a 50-hour test run including six shutdown–restart cycles. Radiometric measurements indicate that the FTA source provides adequate brightness, good uniformity, reasonable spectral match, excellent concentration of the radiant energy into a restricted zone, simple optical collection, and sufficient stability to be a promising source for solar simulation purposes. Author

N65-13521# Naval Civil Engineering Lab., Port Hueneme, Calif.
NAVY LABORATORIES RESEARCH PROGRAM Annual Report, FY 1964
Sep. 1964 19 p refs
(Y-RO11-01; AD-449534)

Abstracts of papers and very brief summaries of work on 28 projects are presented, several of which are concerned with the properties of concrete, with piles and pilings, and with various potentially useful properties of sea water. D.E.W.

N65-13608 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A BIAXIAL TESTER
Anthony San Miguel *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 561–572 refs (See N65-13577 04-34)
(ARPA Order 107-62)

The construction of a versatile biaxial sheet tester is described that is capable of changing or maintaining a relatively uniform rectangular boundary geometry upon a sheet of solid propellant as a function of time. This instrument is analogous to two perpendicularly mounted uniaxial tension machines. Two load cells monitor the instantaneous loading conditions, transmitted to the sheet specimen by means of two independently controlled loading mechanisms. The instrument is designed to induce strains of up to 50% on a propellant sheet specimen 6 $in.^2$ and 1/10 in. thick. A whiffletree arrangement transmits the load from the specimen to the load cell. The whiffletree is provided with a cross-stretch-compensating mechanism to insure that the loading attachments ride freely when subjected to various biaxial loading schemes. A method is suggested to approximate the magnitudes of the biaxial stresses at the center of the propellant sheet. A biaxial relaxation test was performed on a solid propellant to illustrate the potential of the instrument. Author

N65-13618# Craig Systems, Inc., Lawrence, Mass.
ADVANCED DEVELOPMENT MODEL SHELTER, ELECTRICAL EQUIPMENT S-250 ( )/G Final Report, 23 Dec. 1963–22 Jul. 1964
Charles E. Watt 8 Sep. 1964 53 p
(Contract DA-36-039-AMC-03749(E))
(TR-158; AD-451051)

The design and testing of advanced models of an electrical equipment shelter utilizing foam-in-place polyurethane construction are reported. The payload-simulating arrangement consisted of eight individually fabricated weights, about 242 pounds each, bolted to the shelter with adapter brackets. The first shelter with modifications failed the transverse rail hump, the rain, the fording, and the air-tightness tests. Inability of the shelter to pass rain, fording, and air-tightness tests was traced to minor wrinkling around the door opening that occurred during the transverse rail hump test. The wrinkling at the door opening was not made worse by the drop tests. A second shelter that incorporated additional modifications in the door end panel was subjected to the above tests for design verification. This shelter passed all tests without damage, including a check of rf integrity. D.E.W.

N65-13620# Stanford U., Calif. Stanford Linear Accelerator Center
TWO-MILE ACCELERATOR PROJECT Quarterly Status Report, 1 Apr.–30 Jun. 1964
Oct. 1964 108 p refs
(Contracts AT(04-3)-400; AT(04-3)-515)
(SLAC-32)

Developments are reported in *Plant Engineering, Systems Engineering and Installations, Accelerator Physics, Instrumentation, Heavy Electronics, Mechanical Design and Fabrication, Klystron Studies, Mark IV Program, Beam Switchyard, Target Area Development,* and *Preoperations Research and Development.* R.L.K.

N65-13625# ARO, Inc., Arnold Air Force Station, Tenn. Propulsion Wind Tunnel Facility
GENERAL CONSIDERATIONS OF MHD ACCELERATION FOR AERODYNAMIC TESTING
Leon E. Ring Arnold Eng. Develop. Center, Dec. 1964 42 p refs Presented at the AGARD Specialists Meeting on 21–23 Sep. 1964, Rhode-Saint-Genèse, Belgium
(Contract AF 40(600)-1000)
(AEDC-TDR-64-256; AD-453419)

Estimates of magnetohydrodynamic (MHD) accelerator performance limitations show that velocities of 30 000 to 40 000 fps at high density should be attainable with a Faraday accelerator. Operation near atmospheric pressure using seeded air is suggested; order of magnitude estimates indicate the seed material should not affect most aerodynamic testing. The possibility of increased performance by using nonequilibrium electrical conductivity is discussed. Author

N65-13789# Royal Swedish Academy of Sciences, Stockholm. Nobel Inst. of Physics
DEVELOPMENT OF METHODS AND TECHNIQUES FOR INVESTIGATION IN THE VACUUM ULTRAVIOLET AND RESEARCH IN THE REGION OF RADIATION Final Report, 1 Jul.–30 Sep. 1963
Manne Siegbahn 15 Nov. 1963 13 p
(Contract AF 61(052)-462)
(AD-602501)

Gratings for grazing incidence were ruled and tested. Spectra with good intensity and high resolution down to at least 50 Å were registered with good blaze in the first order. The second order was less than 5% of the first order in the shortest wavelength region. It was not possible to find any optical firm that could polish toroidal mirrors of the precision needed for gratings at grazing incidence. Two spectrometers to cover the

region 20 Å to 2000 Å were designed and built. The grazing incidence spectrometer was for gratings with a radius of 3 meters, whereas the one for (nearly) normal incidence was for 2-meter gratings. The grazing incidence spectrometer was mainly used with a grating having 540 lines/mm and with an incidence angle of 5° so that it covered the wavelength region 50 Å to 800 Å, with a dispersion at 100 Å of 0.8 Å/mm and at 700 Å of 1.7 Å/mm. The nearly normal incidence spectrometer was mostly used with a grating having 1080 lines/mm giving a dispersion of 4.6 Å/mm. It covered the wavelength region 300 to 2000 Å. New types of light sources for the shortest wavelength region were investigated. These included hollow cathode and 3-electrode sources. R.L.K.

N65-13792# ARO, Inc., Arnold Air Force Station, Tenn.
DEVELOPMENT OF A STEADY-FLOW JxB ACCELERATOR FOR WIND TUNNEL APPLICATION
K. E. Tempelmeyer, A. K. Windmueller, and L. E. Rittenhouse Arnold Eng. Develop. Center, Dec. 1964 57 p refs Presented at the AGARD Specialists' Meeting on "Arc Heaters and MHD Accelerators for Aerodynamic Purposes," Rhode-Saint-Genèse, Belgium, 21–23 Sep. 1964
(Contract AF 40(600)-1000)
(AEDC-TDR-64-261; AD-452942)

Electrical discharge and material tests have been made in a supersonic seeded nitrogen plasma at static temperatures and pressures near 3000° K and 1 atm, respectively. Cooled copper electrodes set flush in a wall could be made to carry sufficient electrical currents to make MHD acceleration feasible and still have negligible erosion. Sprayed beryllium oxide was found to be the best insulation material of those tested for the conditions at which a high-pressure accelerator must operate. The design of a water-cooled accelerator having 117 pairs of segmented electrodes, and the initial success of prooftests with a prototype twenty-pair electrode accelerator are described. Electrode current fluctuations and various problems associated with seeding the plasma are pointed out as important problem areas for future work. Author

N65-13805# Training Center for Experimental Aerodynamics, Rhode-Saint-Genèse (Belgium).
MODULATION TECHNIQUES FOR MEASUREMENTS IN LOW DENSITY HYPERSONIC WIND TUNNELS
J. J. Smolderen [1964] 15 p Presented at the 22d Semiannual Supersonic Tunnel Assoc. Meeting, Rhode-Saint-Genèse, Belg., 24–25 Sep. 1964
(AD-607382) OTS: $1.00

A new technique for the measurement of small forces or other low-level effects was developed at the VRIFD low-density wind tunnel. Measurement of forces, as low as 10 micrograms, appears feasible when using ferroelectric transducers in conjunction with a low-level tuned amplifier system and synchronous demodulator. This performance is made possible by periodically screening the flow on the model, or even chopping the full flow of the wind tunnel by means of a mechanically actuated screen. Such modulation techniques, which result in considerable noise and drift reduction because of the narrow bandwidth of a system using synchronous demodulation, are widely used for the measurement of low-level dc signals as well as detection of weak radiation, molecular beams, and biological phenomena. Author

N65-13868*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
FILTER-WHEEL SOLAR SIMULATOR
Joseph Mandelkorn, Jacob D. Broder, and Robert P. Ulman Washington, NASA, Jan. 1965 10 p refs Presented at the Fourth Ann. Photovoltaic Specialist's Conf., Cleveland, Ohio, Jun. 2–3, 1964
(NASA-TN-D-2562) OTS: HC $1.00/MF $0.50

A simple low-cost filter-wheel solar simulator for measurements of characteristics of silicon solar cells is described. The simulator has been used to determine outer-space short-circuit currents and to analyze spectral response of cells and performance of cells with antireflective coatings. Values of equivalent outer-space short-circuit currents for unbombarded and electron-bombarded cells were measured by using the simulator and were compared with values from airplane flights. The values agreed within 2%. Correction factors for the short-circuit current of proton-bombarded cells, which compensate for the low-level illumination of the filter-wheel simulator, were determined. Author

N65-13875 Hughes Aircraft Co., Culver City, Calif. Communications Div.
SATELLITE COMMUNICATIONS TERMINAL AN-MSC 46( ) Second Quarterly Progress Report, 15 Apr.–15 Jul. 1964
H. E. Ross [1964] 211 p refs
(Contract DA-36-039-AMC-03744(S))
(FR-19-124; CDP-1568; AD-607185) OTS: $6.00

Progress is reported on a program to design, fabricate, assemble, and test a microwave air and ground transportable satellite-communication link terminal and all auxiliary items necessary for operation with medium-altitude active satellite repeaters and, subsequently, for operation with 24-hour synchronous satellites. Work is reported in the areas of systems engineering, vehicles, power distribution and control, circuit and mechanical design of the console, terminal equipment design, exciter–modulator material acquisition, power amplifier design, antenna layouts and mockups, antenna feed system, servosystem, radome, parametric amplifier, microwave receiver, post-RF receivers, and a link-terminal simulator. D.E.W.

N65-13888# Los Alamos Scientific Lab., N. Mex.
A PULSED HIGH ENERGY RADIOGRAPHIC MACHINE EMITTING X-RAYS. I. THE RADIATION PROBLEM
Douglas Venable 22 Dec. 1964 344 p refs
(Contract W-7405-ENG-36)
(LA-3130) OTS: $7.00

In planning flash radiographic experiments to facilitate the study of explosives and explosive-driven metal systems which demand penetration of thick sections, it is necessary to know the optimum radiation spectrum for the material being radiographed, how to generate this spectrum with the required flux, and the transmission characteristics of various spectra when penetrating experimental assemblies. The information needed to provide estimates of answers to these problems is presented. This includes a survey of bremsstrahlung production as a function of both electron energy and target material, the intensity-angle distribution of the useful radiation, and the transmission and spectral degradation of bremsstrahlung through materials which are possible candidates for experimental systems. The most important parameter in this study is the electron energy which was varied from 5 to 100 MeV. Target materials ranged from beryllium to uranium, with tungsten chosen as most suitable because of its refractory properties and its high bremsstrahlung production efficiency. Author

N65-13933 National Physical Lab., Teddington (Gt. Brit.) Aerodynamics Div.

MILLISECOND MEASUREMENTS OF AERODYNAMIC FORCES IN A HIGH PRESSURE SHOCK TUNNEL

L. Pennelegion, G. S. Smith, and K. Dolman *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 20 p refs (See N65-13922 04-14)

A description is given of a low frequency antivibration mounting which effectively isolates the test section sting and model from the acceleration loads of the shock tunnel firing. The design of a two-component strain-gaged force balance is described and measurements presented of the response time and change in dominant frequency with variation in model weight. The performance of the balance in the shock tunnel is assessed at $M_\infty = 11.6$ using a 60° cone, hemisphere and cylinder having the same base diameter, for a range of helium driver gas pressures up to 8000 lb/in^2. The final accuracy of the measurement is discussed and takes account of the calibration and equipment readout. Author

N65-13935 Princeton U., N.J.

A WIND TUNNEL MAGNETIC SUSPENSION WITH MINIMUM COUPLING EFFECTS

Theodor A. Dukes and Ricardo N. Zapata *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 15 p refs (See N65-13922 04-14)

In a multidegree-of-freedom suspension system coupling effects are undesirable because they make the calibration difficult and they can cause deterioration of the dynamic stability of the system. This paper presents an analysis of the coupling problem leading to the design of a particular system configuration. First, the support of spherical models by means of a three-degree-of-freedom magnetic suspension system is analyzed in terms of the forces acting on a magnetized point. It is shown that long axisymmetrical bodies can also be supported by the same system. This is made possible by decoupling the angular and the translational degrees of freedom. Author

N65-13937 Southampton U. (Gt. Brit.)

OSCILLATORY EXPERIMENTS IN SHORT DURATION HYPERSONIC TESTING FACILITIES

R. A. East *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 21 p refs (See N65-13922 04-14)

The design of a free oscillation technique for the measurement of aerodynamic pitching derivatives in a hypersonic airflow is discussed, and the feasibility of performing oscillatory experiments in short duration wind tunnel facilities of the shock/gun tunnel type is assessed. The limitations of the technique are given showing the regime in which oscillatory experiments are considered possible. An experiment using the technique in a hypersonic gun wind tunnel at $M = 9.7$ and Reynolds Number of 3.7×10^5 is described, and some experimental values of the aerodynamic stiffness and damping derivatives are given which demonstrate that useful results are obtainable from brief duration facilities. A description is given of the measurements required and instrumentation used for timing and recording the model oscillation. Author

N65-13939 General Electric Co., Philadelphia, Pa. Space Sciences Lab.

SHOCK TUBE INSTRUMENTATION TECHNIQUES FOR STUDY OF HYPERVELOCITY ENTRY PROBLEMS

J. S. Gruszczynski and D. A. Rogers *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 20 p refs (See N65-13922 04-14)

The primary objective is to describe shock tube instrumentation techniques developed especially for the study of convective heat-transfer and the radiative properties of high temperature gases at conditions simulating hypervelocity entry into planetary atmospheres. An electrically heated, helium-driven shock tube is used to produce the required flow environment. It is shown that measurement methods suitable for studies in conventional shock tubes must be modified considerably before they can be successfully used in the hypervelocity shock tube. Extremely high shock velocities necessary for proper simulation of the thermochemical state of the gas are associated with very short test times which impose a requirement for fast response instrumentation systems. Also, the partially ionized gas produces interference with the small electrical signals from model heat transfer gages. The methods used to overcome these difficulties are presented, and the potential applicability of existing techniques at even higher shock velocities is discussed. Author

N65-13940 Rolls-Royce Ltd., Littleover (Gt. Brit.) Advanced Research Dept.

ANOMALOUS MEASUREMENTS OF SHOCK VELOCITIES IN ARGON DUE TO PRECURSOR EFFECTS

R. J. Hill *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 13 p refs (See N65-13922 04-14)

The measurement of the velocity of shock waves travelling at high Mach numbers is complicated by precursor effects due to radiation or to diffusion from the shock front. In shock tubes the signals from shock detectors, such as thin film gages or ionization probes, are modified, and the microwave doppler method of velocity determination may be unreliable. Experiments carried out in argon at 5 and 10 torr in a range of Mach number 8 to 18 are described, from which a reliable system using ionization probes was developed. In addition, simultaneous measurements of velocity by microwave and other methods are compared, and the reasons for the large discrepancies that are observed are examined. Author

N65-13941 Polytechnic Inst. of Brooklyn, N.Y.

MICROWAVE TECHNIQUES APPLICABLE TO SHOCK TUBE MEASUREMENTS

Samuel Lederman, Manlio Abele, and Marian Visich, Jr. *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace simulation Facilities [1964] 19 p refs (See N65-13922 04-14)

Several microwave techniques for the measurement of aerodynamic and electromagnetic properties of the flow fields in shock tubes are presented. In particular, microwave techniques applicable to the measurement of shock velocity, running time, and electron density are discussed. By using the driven section of the shock tube as a waveguide which is excited by a single-microwave antenna, simultaneous measurements of shock-velocity attenuation and running time are obtained. The results of the running-time measurements using the microwave method are compared with other diagnostic techniques. Measurements of electron densities are conducted with microwave resonant cavities. Two specific cavity arrangements are presented which are used to measure a wide range of electron densities corresponding to plasma frequencies below and above the resonant frequency. Author

N65-13962*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SOME TRANSIENT ELECTRICAL CHARACTERISTICS OF THE EXHAUST OF A SELF-CROWBARRED COAXIAL PLASMA GUN

Charles J. Michels Washington, NASA, Jan. 1965 18 p refs
(NASA-TN-D-2571) OTS: HC $1.00/MF $0.50

An experimental investigation of the discharge from a self-crowbarred coaxial plasma gun was performed by using Rogovsky loops, framing and streak cameras, and magnetic-field probes. The discharge appears first as a weak-intensity diffuse plasma puff, whose velocity, as determined from streak-camera photographs, is the same as the velocity of the current front, as determined by magnetic probes in the gun annulus. Its location coincides with the extrapolated location of the current front. A short time later, an intense well-collimated elongating luminous core of plasma appears from the tip of the center electrode. The velocity of this core front is slightly less (and diminishing with time) than the current-front velocity. Rogovsky loop measurements indicate that this core is part of a closed current path between the gun electrodes and is current-carrying at a point well downstream of the muzzle. Author

N65-14152# Warner and Swasey Co., New York, N.Y. Control Instrument Div.
INFRARED TECHNIQUES FOR AIR TEMPERATURE MEASUREMENTS IN A HYPERSONIC WIND TUNNEL
Gunter J. Penzias, Richard H. Tourin, and Stanley A. Dolin Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Oct. 1964 24 p refs
(Contract AF 33(616)-8319)
(ARL-64-170; AD-608983)

Infrared spectroradiometric techniques were developed for measurement of high gas temperatures with microsecond time resolution. Procedures for using a high-speed monochromatic radiation pyrometer were established, and temperature in gaseous detonations were measured to determine instrument performance. Breadboard modifications were made to the high-speed pyrometer to enable its use for measuring air temperatures in a Mach 20 hypersonic wind tunnel. The temperature-measuring technique was demonstrated by measuring the temperature of a propane–air flame at atmospheric pressure with the high-speed infrared pyrometer installed on the wind tunnel. The flame was located in the test cabin and the measured temperature was 2050° K. Author

N65-14172# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group
A STUDY ON IMPROVING ELECTRONIC CONTROL OF AIRCRAFT POP-UP ARRESTING SYSTEMS Technical Documentary Report, Jul.–Oct. 1963
Paul L. Kittinger Aug. 1964 19 p ref
(SEG-TDR-64-38; AD-607130)

The purpose of this study was to determine if a more satisfactory and universal aircraft arresting system could be obtained at a cost equal to or less than the present pop-up arresting system. Primarily, the study was to examine the present electronic control circuitry and determine the modifications and/or developments necessary to provide increased control of and utilization for many aircraft. Requirements of the arresting system control circuitry were to determine the particular aircraft weight class, velocity, and direction of travel along the runway. Logic networks were to be used for these purposes. The pop-up arresting cable would be ejected at the time determined by the control circuitry to engage an arresting hook located on the aircraft behind the main landing gear. Various aircraft were studied, graphical data were constructed, and basic logic networks were utilized. It was concluded that due to the complex information desired and the limits imposed, the resulting system would not meet the desired requirements. Author

N65-14176*# General Dynamics/Astronautics, San Diego, Calif.
STUDY TO ESTABLISH ELECTROMAGNETIC COMPATIBILITY SPECIFICATIONS, PHASE I
F. M. Millican 27 Nov. 1964 88 p refs
(Contract NAS8-11426)
(NASA-CR-60077; ZZK-64-200) OTS: HC $3.00/MF $0.75

The problem of automatic checkout of the electromagnetic compatibility (EMC) of large space-vehicle systems in an unfavorable electromagnetic environment was considered from the point of view of using existing component and subsystem tests and criteria or of devising tests and criteria in which the data obtained and conclusions drawn may be directly usable in checking the EMC of the assembled vehicle system. Through a combination of analysis and experiment, several potential modifications to traditional interference testing and the associated criteria are under study. These modifications take the form of elimination of redundant testing, revisions, to existing tests, and addition of new tests. The detecting problems associated with measuring the parameters of interest are being investigated to a limited extent. All of these considerations are being carried out by having in mind the end goal desired — the automation of EMC checkout. Author

N65-14177*# Alabama U., University.
RESEARCH IN THE AEROSPACE PHYSICAL SCIENCES Third Semiannual Report, Mar. 1–Aug. 31, 1964
27 Oct. 1964 78 p refs
(Grant NsG-381)
(NASA-CR-60068) OTS: HC $3.00/MF $0.75

Studies for the following subjects were performed: *Effect of Gas Surface Interaction Potential on Energy and Momentum Transfer in High Knudsen Number Gas Flow, Particularly for Condensable Gas Media; Closed Invariant Subsets of Enveloping Transformation Groups; An Elementary Problem of Numbers; Studies on the Influence of Outer Stream Vorticity on Steady and Unsteady Laminar Flows of the Boundary Layer Type; Similar Flows about Axisymmetric Bodies Rotating in a Fluid at Rest; Studies on Heterogeneous Continua; Studies in Hypersonic Flows; Projects in Mathematical Theory of Automatic Control; Pulse Modulated System with Adaptive Threshold;* and *Groove Guide Measurements.* G.G.

N65-14191# Marquardt Corp., Van Nuys, Calif.
STUDIES OF ADVANCED GROUND TEST FACILITIES FOR AIRBREATHING PROPULSION, 3 YEAR PROGRAM, 1963–1965
R. C. Miller [1962] 19 p Presented to Aeron. Systems Div., Wright-Patterson AFB, Ohio, 20 Nov. 1962
(MR-20207)

These research programs were proposed to advance the technology of engine ground test facilities for power plants and vehicles operating at high altitudes and up to flight velocities of 26 000 fps. The major study areas are: (1) electric arc heater research; (2) magnetogasdynamic accelerator research; (3) high-pressure air generation research; (4) pulse facility studies; (5) MHD power generation research; and (6) facilities design. The major objectives and costs of each program are summarized. R.L.K.

N65-14277# Federal Aviation Agency, Atlantic City, N.J. Evaluation Div.
EVALUATION OF THE CLOSED-CIRCUIT-TELEVISION PILOT WEATHER-BRIEFING FACILITY AT LAMBERT FIELD, ST. LOUIS, MISSOURI Final Report

Edward F. Kups Mar. 1964 96p refs
(RD-64-44; AD-607250) OTS: $4.00

Two closed-circuit-television systems were evaluated for legibility of display, freedom from interference, accuracy of the displayed information, reliability, and man–machine compatibility. The ability of the briefer to convey clear and complete weather information when using the television method as compared to using the telephone briefing method was investigated. It was concluded that the conveyance of complex weather situations verbally, using the telephone method without the ability to display weather charts to the pilot, hampers the briefer in the portrayal of weather situations, and limits the pilot's ability to assimilate the weather conditions discussed. It was further concluded that the method of utilizing a closed-circuit-television system for pilot weather briefing provides the pilot with essentially the same weather chart data and weather information, at a remote location, that he would receive had he appeared in person at the Flight Service Station. This method is a considerable advance over the standard telephone weather briefing method. Pilots readily accepted the new concept and considered this type of weather briefing as excellent. Author

N65-14346# Atomics International, Canoga Park, Calif.
STUDY OF SCTI CONTROL SYSTEM
C. W. Griffin, ed. 1 Dec. 1964 267 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8119)

The Sodium Components Test Installation (SCTI) is a 35-Mw design capacity fossil-fired test installation with a primary and secondary system, a sodium-heated steam generator, a pressure-reducing system desuperheater to simulate the turbine, a condenser, and a feedwater cooling system. Stability studies of the control systems associated with this complex were performed on analog equipment. The greatest difficulty was encountered in attempting to describe the IHX and once-through steam generator in simple mathematical terms, especially since very little could be found in the literature on once-through steam generators. It was discovered that a single-node representation of the IHX was ample for purposes of obtaining controller settings and stability determinations. However, a 3-node simplified model of the steam generator proved inadequate in studying low-flow conditions. Author

N65-14356# Technical Operations Research, Burlington, Mass.
DEVELOPMENT OF A RESEARCH CAPABILITY FOR ACCELERATING HYPERVELOCITY PARTICLES
H. C. Stevens, R. W. O'Neil, and V. E. Scherrer 30 Oct. 1964 42 p
(Contract AF 33(657)-10316)
(TO-B-64-89; AFML-TR-64-333; AD-607955)

A hypervelocity facility was developed and installed for accelerating small particles to meteoric velocities for simulating the effects of micrometeoroid impact on materials. The particles are accelerated by discharging an electronically triggered, high-energy capacitor storage system into an exploding-foil gun. High-speed streak and framing cameras measure particle velocity, size, shape, and momentum. Electronic instrumentation is provided to measure capacitor bank discharge characteristics and energy input to the exploding-foil gun. Particles have thus far been accelerated in this facility to velocities greater than 40 000 ft/sec. Author

N65-14365# Litton Industries, San Carlos, Calif. Electron Tube Div.
PLASMA-POWERED COHERENT OPTICAL TRANSMITTER Final Report, Jul. 1963–Aug. 1964
Gerold Pokorny, Joseph Stafford, Gerald Secrest, Gerald Cox, and James Clauss 30 Oct. 1964 44 p refs
(Contract AF 33(657)-11399)
(DORF-173; AL-TDR-64-257; AD-450741)

This report covers work on the development of a high intensity uv source centered at 254 mμ with spectral output of less than 1 mμ. The uv source is used to pump phosphors which in turn pump laser materials which have absorption bands in the emission spectrum of the phosphor. The uv source can also be used to directly pump laser materials where they efficiently absorb at 254 nm. An experimental study of the mercury discharge mechanism and phosphor efficiency was accomplished. The lack of a commercially available spectral radiometer in the uv region made it necessary to build and calibrate one for the program. Following the evaluation of the discharge and phosphors, a laser pump was constructed to try the uv phosphor technique on an Nd^{+3} doped $CaWO_4$ crystal. Author

N65-14468# ITT Federal Labs., Nutley, N.J.
MOBILE GROUND STATIONS. PART I: THEORETICAL STUDIES Task Report, 1 Jul.–31 Dec. 1963
R. Waer, M. Epstein, G. Pflumm, A. Werth, and I. Sugai Jan. 1964 287 p refs
(Contract DA-36-039-SC-90886)
(TD-64-24; AD-453731)

Some of the operational and preoperational requirements of a mobile ground station are defined. The techniques of determining the position of a ground station and predicting local satellite trajectory for acquisition and tracking are discussed. To determine the accuracy required to enable operation, an analysis of errors in pointing data caused by errors in assumed station position is presented. This is followed by the development of graphical acquisition aids in the form of maps, computer generated tables, and trajectory overlays. The report concludes with an examination of program tracking as a mode of operation in a satellite communication system, with particular emphasis on the use of local station digital computers. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-13364# General Applied Science Labs., Inc., Westbury, N.Y.
LINEARIZED APPROXIMATIONS TO THE BOUNDARY LAYER EQUATIONS
Joseph A. Schetz and Joseph Jannone Jun. 1964 63 p refs
(TR-448; AD-604430) OTS: $3.00

The general subject of linearized approximations to the boundary-layer equations as a source of approximate solutions for viscous-flow problems is considered from a unified viewpoint. Various methods based on this concept and proposed in the literature are reviewed and applied to two specific nonsimilar flow problems, to affect a comparison of quantitative results. Linearization in the von Mises plane is considered and its typical results are compared with those of the conventional physical plane linearization techniques. In this regard, the use of the total pressure rather than the velocity as the dependent

variable is shown to have important advantages, both conceptual and quantitative, even for constant pressure flow problems when subjected to a linearized treatment. Finally, specific recommendations are made about the approach best applied to a specific type of physical problem. Author

N65-13367# Columbia U., New York, N.Y. Plasma Research Lab.

A KINETIC-THEORETIC DESCRIPTION OF THE FORMATION OF A SHOCK WAVE

C. K. Chu Jun. 1964 29 p refs
(Contract AF 49(638)-1254; NSF G-24351)
(Rept.-11; AD-606511) OTS: $3.00

The classical Riemann problem—the flow of a gas in a shock tube—is treated in the context of kinetic theory as an initial value problem for the one-dimensional Krook equation. The only simplifying assumption made is that the gas is one-dimensional: its particles all move in one direction. This corresponds to a gas with an adiabatic constant $\gamma = 3$. A finite-difference method is proposed, utilizing the fact that for sufficiently small time intervals, the gas experiences essentially free molecular flow, so that the collision effects can be treated as a first-order correction. The conservation laws are not used. The computed results generalize the classical solution: the computed solution agrees well with the classical solution, but in addition, has shock structure, diffusion of the contact discontinuity, and dispersion of the expansion wave, all incorporated. The same procedure is used to calculate steady-state shock structure, to which the shock developed in the shock tube is compared. Author

N65-13388 United Nuclear Corp., White Plains, N.Y. Development Div.

SELECTED PARAMETERS FOR TWO-PHASE FLOW OF SODIUM

Kurt Goldmann 16 Aug. 1963 *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeeting Dec. 1964 p 270–292 refs (See N65-13376 04-34) OTS: $7.00

Selected two-phase flow parameters for sodium systems are presented. They are based on analytic techniques which proved useful for water systems in earlier studies. Thus, flow pattern charts are developed that are similar to those given for water elsewhere, and two-phase pressure drop and vapor-volume fraction data are presented following this approach. The agreement found between analytic and experimental results for water supports the anticipation of similar agreement in this case. The results presented should be usable for the scoping design of sodium systems. D.E.W.

N65-13389# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. Tapco Group

STABILITY OF PARALLEL-PATH TWO-PHASE FLOW

Thomas J. Vild and Donald E. Sill *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Dec. 1964 p 293–315 refs (See N65-13376 04-34) OTS: $7.00
(Contract NAS5-462)

The requirements for stable operation of a parallel-tube mercury condenser capable of flowing in opposition to 1 g were investigated analytically and experimentally. Included in the analyses were the effect of geometric and thermodynamic unbalances between tubes, header pressure loss, magnitude and direction of the gravity vector, and fluid-wall contact angle The analytical conclusions were verified by experiment on a small-scale condensing apparatus and applied to a full-scale prototype condenser The results of the analyses, the small-scale tests, and the testing of the full-scale prototype are presented. Author

N65-13436# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF A HYPERSONIC FLOW OF SLIGHTLY RAREFIED VISCOUS GAS AROUND A FLAT PLATE

V. S. Galkin 24 Jul. 1963 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 3, 1961 p 18–21
(FTD-MT-63-52/1+2; AD-607970)

The calculation of the drag coefficient of a flat semi-infinite heat-insulated plate in a hypersonic gas flow with slip is described. It is assumed that the region of flow between joined strong jumps of the packing and the plate consists of a nonviscous zone and laminary boundary layer. The strong interaction of the jump with the layer is considered. In calculation of the boundary layer the integral form of the equation of pulses with linear profile of speed is used, taking into account the speed of slip. Parameters of flow on the external boundary of the boundary layer are calculated by the method of tangential wedges. The gas is ideal; the Prandtl number $\sigma = 1$; and the reflection of molecules from the plate is diffused. Author

N65-13439# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL INVESTIGATION OF OUTFLOW OF A BOILING LIQUID THROUGH A CENTRIFUGAL INJECTOR NOZZLE

V. A. Makhin, V. F. Prisnyakov, and I. F. Tokar' 21 May 1964 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 4, 1962 p 139–144
(FTD-MT-63-295; AD-606749)

Two methods are presented for the study of the outflow of boiling liquids through a centrifugal injector nozzle: the visual observation of the evaporation and the outflow in a glass container with an injector nozzle mounted in its metal bottom, and the quantitative observation of essentially the same method, but employing two-phase mixtures and a screw-type nozzle. The saturation temperatures were measured and the various flow rates were determined. The pressure and the temperature of boiling water before the injector nozzle corresponded to the state of saturation and the coefficient of the discharge were less than for the outflow of nonboiling water. A kerosene mixture flows into the discharge medium under a pressure greatly exceeding its vapor pressure. The outflow of mixtures containing a large quantity of low-boiling fractions took place at pressures near the vapor pressure of the low-boiling component. G.G.

N65-13520# Purdue U., Lafayette, Ind.

NATURAL CONVECTION EXPERIMENT WITH MERCURY IN A TRANSVERSE MAGNETIC FIELD

R. J. Mac Gregor and P. S. Lykoudis Oct. 1964 53 p refs
(NSF GP-927)
(A&ES-64-9)

An experiment was performed wherein natural convection of mercury in the presence of a heated vertical plate was found to be inhibited by a transverse magnetic field. A magnetic field varying as the inverse fourth root of the distance up the plate was used. This magnetic field geometry is necessary for the existence of a similarity solution. The data obtained from a temperature probe traversing the boundary layer were found to be consistent with existing theories. Author

N65-13528# Stanford U., Calif. Thermosciences Div.
A LITERATURE REVIEW ON SUBSONIC FREE TURBULENT SHEAR FLOW
R. M. Halleen Apr. 1964 108 p refs
(Contract AF 49(638)-1278)
(MD-11; AFOSR-TN-5444; AD-606758)

Free turbulent flow is any turbulent fluid flow phenomena not restricted by solid boundaries. Solutions for two-dimensional flow and three-dimensional axially symmetric flow are reviewed for the turbulent shear layer, turbulent wake, and turbulent jet. For each topic, the defining partial differential equations for the particular turbulent shear stress models and geometric conditions are given, followed by the transformation of the variables utilized in obtaining a solvable differential equation. Experimental mean velocity profile data for each condition are correlated and reduced to a single curve using the least squares curve fitting technique. A table of coordinates for each curve is given, including the standard deviation from the mean. Author

N65-13534*# United Aircraft Corp., East Hartford, Conn. Research Labs.
INVESTIGATION OF NONEQUILIBRIUM FLOW EFFECTS IN HIGH EXPANSION RATIO NOZZLES Final Report
V. J. Sarli, W. G. Burwell, and T. F. Zupnik 3 Dec. 1964 91 p refs
(Contract NAS3-2572)
(NASA-CR-54221; UACRL-C910096-13) OTS: HC $3.00/MF $0.75

These studies have included analyses (a) to determine the sensitivity of calculated nonequilibrium performance to variations in the chemical kinetic rate constants used in the calculations, (b) to establish the limits of applicability of the Bray sudden-freezing criterion for predicting chemical nonequilibium performance, (c) to determine the effect of variations in nozzle contour on nonequilibrium performance, and (d) to determine the effect of nozzle scale (i.e., thrust level) on nonequilibrium performance. The propellant systems selected were H_2-O_2 and N_2O_4-50% N_2H_4/50% UDMH. The results show that the nonequilibrium performance of both selected propellant systems is particularly sensitive to the kinetic recombination rate for the three-body water recombination reaction, $H + OH + M \rightleftharpoons H_2O + M$. The single-reaction Bray sudden-freezing criterion is adequate for predicting the nonequilibrium performance of these two propellant systems. The calculated sensitivity results indicate that a modification of the single-reaction Bray criterion may be necessary in other propellant systems to account for energy contributions from several concurrent chemical reactions taking place during nozzle expansion. Additional results obtained show that increasing the nozzle scale (thrust level) can increase the nonequilibrium specific impulse. The relative magnitude of the performance increase is dependent, however, upon the rocket chamber pressure level. Author

N65-13549*# Maryland U., Baltimore. Inst. for Molecular Physics
PREDICTION OF MUTUAL DIFFUSION COEFFICIENTS FOR THERMAL CONDUCTIVITY DATA
Stanley Weissman 10 Nov. 1964 22 p refs
(Contract NsG-398)
(NASA-CR-59947) OTS: HC $1.00/MF $0.50

The theoretical expression for thermal conductivity of a binary mixture of gases was used to determine the mutual diffusion coefficient of the two gases. The theoretical thermal-conductivity formula was also used to obtain the temperature derivative of the diffusion coefficient at room temperature, and these derivatives in turn are used to predict the diffusion coefficient at several temperatures above and below room temperature. The agreement between predicted and observed diffusion coefficients is good. The temperature derivatives have also been used to calculate thermal-diffusion factors, and the agreement is satisfactory considering the great sensitivity of the thermal-diffusion factors to small errors in the derivatives. Author

N65-13554*# Rensselaer Polytechnic Inst., Troy, N.Y.
ON NON-STEADY LIQUID DISCHARGE FROM RESERVOIRS
W. B. Brower, Jr. and J. L. Way Aug. 1964 48 p refs
(NASA-CR-59657; TR-AE-6407) OTS: HC $2.00/MF $0.50

A group of problems involving time-dependent discharge of inviscid liquid from a reservoir are examined. Two geometries are treated in detail—the slender conical reservoir and the cylindrical reservoir. The differential equation governing free-surface motion during discharge is nonlinear and cannot be integrated exactly except for the special geometry of a cylindrical reservoir. However, in the two cases treated, the possibility of neglecting the free-surface acceleration in order to obtain approximate unsteady solution is shown. For the cylindrical reservoir, meaningful comparison with experiment is possible only with an exit nozzle, and even then special precautions must be taken to avoid free-surface collapse. Other theoretical work considered employs momentum and kinetic energy correction factors to account for the lack of uniformity of the flow across any cross section normal to the axis. D.E.W.

N65-13572*# National Aeronautics and Space Administration, Washington, D.C.
THREE DIMENSIONAL FLOW AROUND BLUNT BODIES WITH ALLOWANCE FOR EQUILIBRIUM PHYSICO-CHEMICAL REACTION [PROSTRANSTVENNOYE OBTEKANIYE ZATUPLENNYKH TEL S UCHETOM RAVNOVESNYKH FIZIKO-KHIMICHESKIKH REAKTSIY]
Yu. N. D'yakonov Jan. 1965 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 157, no. 4, 1964 p 822–825
(NASA-TT-F-301) OTS: HC $1.00/MF $0.50

A new approximation is proposed for the equilibrium thermodynamic functions of gases that is convenient for solving the problems of gas dynamics by an electronic digital computer. With the aid of this approximation, the grid method is used to solve the problem of three-dimensional flow around blunt bodies, allowing for equilibrium physicochemical reactions. The flow of a perfect gas ($\gamma = 1.4$) and an equilibrium gas (air) around blunt bodies was investigated; the computation time for the equilibrium flow was only 3% to 5% greater than the time for computing the ideal flow. D.S.G.

N65-13881 Aeronautical Research Council (Gt. Brit.)
SOME EXAMPLES OF THE USE OF A CONICAL SHADOWGRAPH TECHNIQUE
D. Pierce and D. Treadgold London, HMSO, 1964 15 p refs (ARC-CP-763) HMSO: 3s 6d

A conical shadowgraph technique has been applied to study the flow in the vicinity of the leading edges of slender wings at supersonic speeds. In addition an investigation was made of the shock-wave shape occurring on a triangular expansion surface with near-sonic leading edges. Author

N65-13884# Boeing Scientific Research Labs., Seattle, Wash. Mathematical Research Lab.

THE METHOD OF CHARACTERISTICS FOR THE SUPERSONIC FLOW OF AN IDEAL DISSOCIATING GAS. I: EQUILIBRIUM FLOW Mathematical Note No. 355

F. Edward Ehlers Jul. 1964 50 p refs

(DI-82-0364; AD-607353) OTS: $2.00

The method of characteristics for the supersonic axially symmetric or two-dimensional flow of Lighthill's ideal dissociating gas under thermodynamic equilibrium is formulated, for efficient calculation, by an electronic digital computer. The equations are simplified by the introduction of the streamline slope and the cotangent of the Mach angle as independent variables. Under this transformation, the coefficients in the characteristic differential equations become rational algebraic functions. Procedures for computing the flow conditions at the next downstream interior point and for computing next downstream point along a solid boundary, along a shock wave, and along the axis are described in detail. A complete program coded in FORTRAN for the IBM 7094 computer is listed, and instructions for its use are explained. Author

N65-13899 Joint Publications Research Service, Washington, D.C.

PRINCIPLES OF RADIATION IN ELECTRODYNAMICS OF MOVING MEDIA

B. M. Bolotovskiy and S. N. Stolyarov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 71-76 refs (See N65-13892 04-07) OTS: $6.00

The unique selection of retarded solutions to solve equations in electrodynamics is considered. An expression for the lost energy in a moving medium due to Cerenkov radiation is formed and integrated over the region of possible frequencies. This expression coincides with the expressions for the energy loss of a charged particle moving in a stationary medium with a constant velocity. The direction of the motion remains constant in all frames of reference because of the Lorentz transformation, and only the frequency spectrum varies. A solution is formed to satisfy the physically evident requirements for the case of a moving medium. G.G.

N65-14051# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

SOUND PROPAGATION IN RAREFIED GASES Final Report

Nov. 1964 82 p refs

(Contract Nonr-3697(00))

(BBN-1169; AD-608626)

A study of sound propagation in rarefied gases is described with particular emphasis on the propagation in the geometrical relaxation regime where the sound carrying molecules do not suffer intermolecular collisions during the flight from the transmitter to the receiver. The propagation is characterized by the attenuation and the phase parameters. The dependence of these dispersion parameters on the separation between the transducers, the velocity distribution of the molecules subsequent to their interaction with the transmitter surface and the boundary conditions describing molecular-surface interactions is ascertained in terms of a semiphenomenological theory. Experiments for measuring the dispersion parameters are described, and the results are discussed and compared with theory. A theory and an experiment for determining surface accommodation coefficients using sound propagation in rarefied gas are outlined. Finally a theoretical model is constructed that leads to a reasonable qualitative and quantitative description of sound propagation in rarefied gases. Author

N65-14053# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

ON THE ASSUMPTION OF SPECIFIC-HEAT RATIO NEAR ONE IN THE THEORY OF HIGH-ENERGY GAS FLOWS

F. K. Moore Nov. 1964 30 p refs

(Contract Nonr-2653(00))

(CAL-AF-1285-A-12; AD-608593)

The assumption that the ratio of specific heats is near one is of dominant importance in real-gas flow theory for hypersonic shock layers, scaling for dissociating flows, local similarity of the hypersonic boundary layer, and the theory of weak disturbances of a highly excited gas. Certain of these problems are briefly reviewed, chiefly to explain the advantages conferred by this assumption which, though poor a priori, has the power to unify diverse problems, often with surprising accuracy. Special attention is paid to the real-gas theory of sound waves, showing how a reduction of order is achieved for any process of energy release coupled with a state-variable. Dispersal by chemical relaxation and by radiative transfer is described. Author

N65-14063# General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.

SCALING EXPERIMENTS ON WAKE IONIZATION BEHIND NONABLATING HYPERSONIC SPHERES

A. Q. Eschenroeder and R. A. Hayami Nov. 1964 18 p refs

(Contract DA-01-021-AMC-11359(Z); ARPA Order 347; Proj. Defender)

(TR-64-02L; AD-452260)

Binary scaling is demonstrated for the ionization in the near wake of nonablating blunt objects flying at hypersonic speeds. The experiments employ transverse microwave probe instrumentation used in conjunction with a free-flight ballistic range. For these experiments an accelerated-reservoir light-gas gun is used to launch copper-plastic spheres varying in diameter from 5 to 15 mm The results indicate the validity of the scaling hypothesis but point up its limitations at high ambient densities. Author

N65-14090# Syracuse U. Research Inst., N.Y.

INTERACTION OF A COLUMNAR STARTING VORTEX WITH A PROPAGATING SHOCK WAVE Interim Technical Report

Thomas M. Weeks and Darshan S. Dosanjh Nov. 1964 123 p refs

(Grants DA-ARO(D)-31-124-G210; NSF GP-1137)

(ME-931-6411-IT; AD-452987)

The passage of a plane normal shock wave over a two-dimensional airfoil mounted at an angle-of-attack in a shock tube generated a columnar spiral starting vortex which interacted broadside with the reflected normal shock front. Optical records revealed that a cylindrical acoustic wave front centered on the transmitted vortex is generated behind the reflected shock front. The Lighthill theory of aerodynamic noise generation was applied, and the time-dependent system of applied stresses was obtained from the rapidly changing properties of the vortex due to its interaction with the progressing shock front. The pressure amplitude distribution was found to have the form of a combination of quadrupole, dipole, and monopole acoustic sources. For a wave front radius greater than 10 vortex core radii, the overall agreement between theory and experiment was excellent. Measurements of the vortex density distribution both before and for a short time after interaction were found to agree closely with the one derived from an approximate free vortex analysis. Notable deviations from free vortex decay behavior appeared only after shock interaction. Author

N65-14093# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center
SULFUR HEXAFLUORIDE Data Sheets
John T. Milek Oct. 1964 73 p refs
(Contract AF 33(615)-1235)
(DS-140; AD-607949)

A compilation of the electrical properties of sulfur hexafluoride, a dielectric gas, is presented. Electrical properties include corona, dielectric constant, dissipation factor, and dielectric strength. The latter property data section is divided into parameter effects as follows: pressure, gap distance, temperature, electrode configurations, and gas mixtures. Each property is compiled over the widest possible range of parameters obtained in a thorough search of the world's literature.
Author

N65-14096# California U., Berkeley. Inst. of Engineering Research
THE BASE FLOW PROBLEM AT VERY LOW REYNOLDS NUMBER IN THE OSEEN APPROXIMATION
Henri Viviand and Stanley A. Berger Sep. 1964 44 p refs
(Contract Nonr-222(45))
(AS-64-15; AD-608134)

The influence of inertia terms in the equations of motion on the properties of the base flow and near-wake at very low Reynolds numbers is investigated by using Oseen's approximation and by comparing with previous results obtained for Stokes flow. The general solutions of Oseen's equations of motion are derived for two-dimensional and axisymmetric flows in the half-space $x > 0$, for an arbitrarily given velocity field in the plane $x = 0$. Numerical examples are given for two-dimensional flow and are compared with Stokes flow examples.
Author

N65-14120*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRANSPORT PROPERTIES OF DILUTE GAS MIXTURES
Richard S. Brokaw, Roger A. Svehla, and Charles E. Baker Washington, NASA, Jan. 1965 17 p refs Presented at the Intern. Seminar on the Transport Properties of Gases, Brown U., Providence, 20–24 Jan. 1964; sponsored by NSF
(NASA-TN-D-2580) OTS: HC $1.00/MF $0.50

Experimental diffusion coefficients, mixture viscosities, and mixture thermal conductivities for the binary systems He-Ar, He-H_2, H_2-N_2, Ar-NH_3, and H_2-NH_3 were analyzed to obtain insight as to the concordance between theory and experiment. The analysis suggested the following conclusions: (1) The diffusion coefficients and viscosities of gas mixtures, including mixtures of polyatomic and polar species, are well described by the Chapman–Enskog theory. (2) The Chapman–Enskog theory for the thermal conductivity of monatomic gas mixtures is valid.
Author

N65-14126# Massachusetts Inst. of Tech., Cambridge. Fluid Dynamics Research Lab.
PARAMETRIC AMPLIFICATION OF SURFACE AND INTERNAL WAVES Final Scientific Report
R. E. Kelly Jun. 1964 121 p refs
(Grant AF-AFOSR-156-63)
(MIT Fluid Dyn. Res. Lab.-64-3; AFOSR-64-1827; AD-605728)

The report concerns the possible amplification of waves in fluids due to fluctuations with time of some parameter which defines in part the natural frequencies of the system. Resonance is most likely to occur when some characteristic frequency is half of the frequency of parametric variation. First, the fluid is taken to be within a container which oscillates in the vertical direction so that the gravitational acceleration, relative to the container, varies with time. Both surface waves, in the case of an interface, and internal waves, in the case of a continuous variation of density, are considered. Second, two fluids of different densities are taken to flow parallel to each other in an oscillatory manner and with different mean values of velocity. It is found that the flow is always unstable, although the rates of growth are rather small.
Author

N65-14134# Wisconsin U., Madison. Mathematics Research Center
BLAST WAVE THEORY
Akira Sakurai Sep. 1964 100 p refs
(Contract DA-11-022-ORD-2059)
(MRC-497; AD-608861)

A method to find an approximate solution of an idealized model of the blast-wave problem is developed; the gas-dynamic motion is initiated by an instantaneous energy release from a point source (or line, or plane source). Transformation of variables is introduced with a similarity parameter x as an independent variable, along with a quantity less sensitive to the phenomenon. This reduces the fundamental system of equations of the problem to a manageable form for the approximation, which is conveniently performed in a power series expansion in the variable y; the coefficients of the expansion can be determined successfully from the systems of ordinary differential equations.
Author

N65-14174# Mithras, Inc., Cambridge, Mass.
GAS DYNAMICS OF HIGH-ALTITUDE ROCKET PLUMES Final Report, 1 Jul. 1963–30 Jun. 1964
Henry L. Alden and Roger H. Habert Jul. 1964 81 p refs
(Contract AF 19(628)-3280; ARPA Order 42; Proj. Defender)
(MC-63-80-R1; AFCRL-64-677; AD-607940) OTS: $3.00

This report describes methods for calculation of the velocities and thermodynamic properties of flow fields through and around high-altitude rocket plumes. The main effort is directed at obtaining a good representation of both the jet flow from rocket motors and the shock-mixing layers in the frontal regions; the calculation then proceeds downstream using standard methods. The work may be divided in three parts: the development of methods to calculate the flow fields throughout plumes using the principles of inviscid continuum mechanics; the study of the shock-mixing layer structure at the nose of the plume using the general Navier–Stokes equations (i.e., accounting for viscosity, heat conduction, and diffusion); and an estimate of validity of continuum mechanics for describing high-altitude plumes, as inferred from a study of shock wave formation at high altitudes.
Author

N65-14183# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research & Engineering Center
SOLUTION OF THE INVISCID FLOW DUE TO DISPLACEMENT BY THE METHOD OF INTEGRAL RELATIONS
G. H. Hoffman Oct. 1964 104 p refs
(LMSC/HREC-A710150; H-64-017)

The method of inner and outer expansions as formulated by Van Dyke for the supersonic blunt-body problem is considered. The second term in the outer expansion (inviscid flow due to displacement) is treated by the method of integral relations. Knowledge of this term is necessary in order to solve for second-order effects on the boundary layer. As an illustration, the method is applied to a spherical nose. The first and second approximations of the method of integral relations

are derived, and numerical results are obtained for the first approximation. Results on the body surface are compared with those of the approximate solution given by the shifted–expanded body method. Qualitative agreement is found to exist. The variation of second order shock standoff distance (in air) with Reynolds number is found to be in qualitative agreement with existing experimental results (in argon). Author

N65-14218# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TECHNICAL GAS DYNAMICS
M. Ye. Deych 31 Aug. 1964 646 p refs Transl. into ENGLISH of the book "Tekhnicheskaya Gazodinamika" Moscow, Gos. Energ. Izd., 1961 p 1–671
(FTD-MT-63-197; AD-608090)

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N65-14285# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
A GENERAL THEORY OF STABILITY OF THE MOTION OF A FLUID WITH HEAT TRANSPORT AND ARBITRARY FORCE FIELDS
Richard L. Moore 14 Nov. 1964 61 p refs
(Rept.-31964)

By a method due to Rosseland, the equations of a fluid with nonuniform density and heat addition are reduced without approximation from six equations in six unknowns (by eliminating the density and pressure) to obtain four equations in the four unknowns: the temperature field and the three components of the velocity field. This applies to a perfect gas or a Prim gas. Conditions are obtained for the stability of a dissipationless cylindrical plasma with a gaussian radial density distribution. The vector wave equation which is derived is applied to MHD waves, electron oscillations, in a uniform magnetic field, waves in stratified fluids, and the stability of Poiseuille flow. Theorems for the generation of vorticity have been proved. Author

N65-14304# Naval Ordnance Test Station, China Lake, Calif. Research Dept.
FLOW OF GAS IN TAPERED CHANNEL WITH MASS ADDITION
George L. Delority, Harold H. Bradley, Jr., and E. W. Price Sep. 1964 52 p refs
(NAVWEPS-8606; NOTS-TP-3626; AD-608091)

An analysis was made of adiabatic, steady-state gas flow with combined area change and mass addition. A pseudo-one-dimensional model was assumed. A more detailed flow analysis was made for the class of single port rocket grains in which the differential rate of change of channel port area with respect to burning surface area is constant throughout the length of the grain. The resulting system of equations was coded for the IBM 7090 computer. The change of channel geometry with time was not considered in the analysis. The relationships between various dimensionless groups involving flow variables, channel geometry, and propellant properties are presented in the form of equations and graphs. The relationships reduce to those for constant area flow when a parameter λ is equal to zero. This parameter is positive when the channel area increases with length and is negative when the channel area decreases. The limiting flow for converging channels ($\lambda = -\infty$) represents isentropic flow. Author

N65-14305 Aeronautical Research Council (Gt. Brit.)
A DIRECT INTERATION METHOD FOR THE CALCULATION OF THE VELOCITY DISTRIBUTION OF BODIES OF REVOLUTION AND SYMMETRICAL PROFILES
F. Vandrey London, HMSO, 1964 36 p refs Supersedes ARL/R1/G/HY/12/2, ARC-14579 HMSO: 15s
(ARC-RM-3374; ARL-R1/G/HY/12/2; ARC-14579) HMSO: 15s

An integral equation is derived for the velocity on the surface of a given body of revolution or a given symmetrical profile in longitudinal flow, using the generation of a body by a vortex layer on its surface. The equation can be solved by the usual iteration method for linear integral equations of the second kind. The method of generating a body by a vortex layer leads to formulas expressing the components of the velocity outside the body by means of its pressure distribution. In general, the numerical work is greater for this method than for the indirect methods which use essentially a generation of the body by a distribution of sources and sinks on its axis. On the other hand, the method is not restricted to the case in which the analytic continuation of the flow into the interior of the body does not meet singularities outside the axis. The only requirement is that the shape of the body must have a continuous tangent, whereas its curvature may have isolated discontinuities. Author

N65-14322# Ohio State U. Research Foundation, Columbus. Aerodynamic Lab.
AN EXPERIMENTAL STUDY OF REAL GAS EFFECTS ON SHOCK DETACHMENT DISTANCES AND SHOCK SHAPES FOR A FAMILY OF BLUNT AXISYMMETRIC BODIES Final Report, 1 Jan. 1963–1 Feb. 1964
Bruce C. Graber Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Oct. 1964 44 p refs
(Contract AF 33(657)-104-6)
(FDL-TDR-64-130; AD-608869)

Shock shapes and detachment distances for a group of spherical-nosed bodies are presented and analyzed in terms of their dependence on several of the flow parameters. The experimental data were obtained by testing the models in an arc-driven shock tube facility that produces a high enthalpy supersonic flow behind the traveling normal shock. With the models mounted in this shock-generated supersonic flow, the free-stream conditions with respect to the model were such

that the equilibrium density ratio across the bow shock and the free-stream Mach number vary as $3.1 \leq k \leq 7.2$ and $2.1 \leq M_2 \leq 3.54$, respectively. The stagnation enthalpy range for the tests (2000 to 31 000 BTu/lb_m) allowed for free-stream dissociation and ionization levels of up to 88.0% and 25.0%, respectively. It is demonstrated that the density ratio across the bow shock is the important parameter for correlating the nose region shock shapes since this produces agreement between the real gas data and perfect gas data. Author

N65-14389 North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
ADVANCED CELESTIAL TRACKER TECHNIQUES Technical Documentary Report, Jul. 1963–May 1964
Edward P. French, Lloyd P. Le Blanc, and Francis E. Wochna Wright-Patterson AFB, Ohio. AF Avionics Lab., Aug. 1964 84 p refs
(Contract AF 33(657)-10894)
(SID-64-865; AL-TDR-64-127; AD-607507) OTS: $4.00

Reported is the evaluation of spectral radiation intensities from the shock and boundary layers associated with a hypersonic vehicle. The intended application is to predict the amount of radiant energy reaching the sensing element of a celestial tracker. The analytical phase of the study consisted of numerical solutions of the viscous and inviscid flow equations and the correlation of flow field properties in terms of readily available flight and vehicle parameters. The flow properties, in turn, were used to compute theoretical values of spectral intensity. The intensities were in turn correlated in the form of easy-to-use charts and equations. The experimental phase consisted of the measurement of absolute spectral intensities from the conical portion of blunt cone models in a hypersonic wind tunnel. A scanning spectrometer was built and used to obtain multiple-frequency scans, each lasting about five milliseconds, at two locations in the flow field. Author

N65-14427*# Consultants and Designers, Inc., Arlington, Va.
ON THE CONDITIONS OF STABILITY OF MECHANICAL EQUILIBRIUM [OB USLOVIYAKH USTOYCHIVOSTI MEKHANICHESKOGO RAVNOVESIYA]
G. F. Sitnik 8 Dec. 1964 7 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 5, 1964 p 28–30
(Contract NAS5-3760)
(NASA-TT-F-9607; ST-HT-CM-10256) OTS: HC $1.00/MF $0.50

A nonadiabatic criterion is derived for the stability of the mechanical equilibrium of a gas layer situated in the gravitational field. This criterion points to new possibilities of equilibrium disruption, not provided for by the adiabatic criterion. Author

N65-14444# Syracuse U. Research Inst., N.Y.
THE WALL-JET IN A LONGITUDINAL PRESSURE GRADIENT Annual Report
F. Erian and S. Eskinazi 31 Oct. 1964 34 p refs
(Contract Nonr-669(16))
(SURI-ME937-6410F; AD-607474) OTS: $3.00

The effect of a longitudinal pressure gradient on the nature of the shear stress distribution, as well as the mechanism of energy production, was considered. In addition an attempt is made to determine if the existence of pressure gradients increased, in the flow field, the size of the negative energy-production region. The flow pattern used in conducting the present experiments was composed of a half jet blowing out of a narrow vertical slot of large aspect ratio. The jet was bounded by a smooth, rigid, flat wall on one side, mixing with a slower stream of air on the free side. P.V.E.

N65-14474# Physical Studies, Inc., Centerville, Ohio.
RVIP REENTRY RADIATION MEASUREMENTS. A: THEORETICAL BACKGROUND Scientific Report No. 1
R. G. Breene, Jr. 6 Aug. 1964 55 p refs
(Contract AF 19(628)-2426; ARPA Order 254)
(AFCRL-64-691, Pt. A; AD-454469)

The theoretical background for interpretation of the observed reentry radiation is discussed in detail. The overall categories are free-free, free-bound, and bound-bound radiation, the important subdivisions that are considered extensively in this study. The general progress, both theoretical and experimental, is reported to a limited extent. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-13352# Queens U., Belfast (Northern Ireland).
DIURNAL VARIATION OF THE TEMPERATURE OF THE THERMOSPHERE
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1964 p 1–7 refs (See N65-13351 04-34)

Although direct computation of the diurnal variation of the temperature of the thermosphere is possible in principle, the problem is explored analytically. The solution given by Cummack (1962) to the equation describing the diurnal variation was computed for a wide range of the parameters involved. The results show that the temporal location of the maximum temperature moves from near sunset towards noon with increase in K_0 (the thermal conductivity constant), or with decrease in $P_0\sigma$, where P_0 is the pressure at a lower boundary and σ is the product of the mass absorption coefficient and the acceleration of gravity. The results are being further analyzed to determine whether the observed temporal location is consistent with the hypothesis that the heating is due only to ultraviolet radiation. D.S.G.

N65-13353 Queens U., Belfast (Northern Ireland).
TEMPERATURE OF OI ATOMS RESPONSIBLE FOR THE 6300 Å OI EMISSION OF THE NIGHTGLOW
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1964 p 8–10 refs (See N65-13351 04-34)

Observations of the nightglow 6300 Å OI emission were made with a 7-cm clear-aperture pressure-scanning Fabry-Perot interferometer. Profiles of the 6300 Å nightglow emission yielded temperatures ranging from 500° to 1700° K for the predawn and posttwilight periods. Author

N65-13354 Queens U., Belfast (Northern Ireland).
THE 6300 Å OI DAYGLOW EMISSION
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1964 p 11–13 refs (See N65-13351 04-34)

Using a photographic Fabry–Perot interferometer, a temperature of 814° ±65° K for the 6300 Å dayglow OI emission was derived from a study of 14 profiles from a set of fringes obtained during one exposure. D.S.G.

N65-13355 Queens U., Belfast (Northern Ireland).
VARIATIONS OF HYDROXYL AND OXYGEN EMISSIONS IN THE INFRA-RED AIRGLOW
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1964 p 14–15 (See N65-13351 04-34)

An Ebert-type spectrometer was constructed to achieve superior resolution of variations in the infrared airglow over a wavelength range of 0.6μ to 2.2μ. Various changes made to the associated electronics to increase the sensitivity are described. D.S.G.

N65-13356 Queens U., Belfast (Northern Ireland).
INFRA-RED INVESTIGATIONS OF THE NIGHT SKY USING A MICHELSON INTERFEROMETER
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1964 p 16–18 refs (See N65-13351 04-34)

The Michelson interferometer together with Fourier transformation techniques is useful for infrared studies over the 0.6μ to 2.2μ region. The 20 minute scanning time makes it an excellent instrument for diurnal studies of temperature and intensity variations. The design of a rotating beam Michelson interferometer is discussed. D.S.G.

N65-13357# Queens U., Belfast (Northern Ireland).
ALL-SKY INTERFEROMETER FOR AIRGLOW STUDIES
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1964 p 19 (See N65-13351 04-34)

The impossibility of obtaining narrowband interference filters of adequate diameter and quality for the f/1 interferometer intended for investigations of airglow structure has led to further development of the original f/5 instrument. Author

N65-13368# Massachusetts Inst. of Tech., Cambridge. Geophysics Lab.
LOW-FREQUENCY ELECTROMAGNETIC OSCILLATIONS OF THE EARTH-IONOSPHERE CAVITY
T. Madden and W. Thompson 22 Sep 1964 108 p refs
(NSF G-13575)
(AD-607080)

The observational and theoretical work on the low-frequency electromagnetic oscillations of the earth-ionosphere cavity, known as the Schumann resonances, is reviewed. Additional theoretical considerations are introduced that allow the models to incorporate all the important complications of the real ionosphere. Comparisons between the theoretical predictions and the observational data lead to implications about the structure of the very low ionosphere, and the geometry of ionospheric perturbations which are discussed. Author

N65-13425# Defence Research Board, Ottawa (Canada).
SECULAR VARIATION OF THE GEOMAGNETIC FIELD AND UNUSUALLY ABRUPT CHANGES THEREIN
V. P. Orlov Jul. 1964 12 p refs Transl. into ENGLISH from Tr. Inst. Zemnogo Magnetizma, Ionosferi i Rasprostraneniya Radiovoln, Akad. Nauk SSSR (Moscow), v. 28, no. 18, 1961 p 77–86
(T-402-R; AD-607285)

The geomagnetic secular variation is made up of the following parts: periodic variations having a planetary character; changes produced by physical processes within the earth at a depth of a few thousand kilometers and arising at secular variation centers; changes due to physical processes taking place in the earth's crust; variations connected with physical processes in the upper strata of the atmosphere, and variations due to the influence of changes in solar activity. Unusually large changes of secular variation have extended over all of Eurasia; there is no basis for supposing that those variations observed for the last 5-year period have ceased and will not occur in the next 5-year period. E.C.

N65-13530# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
A STUDY OF ICE FOG AND ICE-FOG NUCLEI AT FAIRBANKS, ALASKA, PART I
Motoi Kumai Aug. 1964 32 p refs
(CRREL-150; AD-451667)

This is a study of Arctic whiteout, i.e., ice fog, supercooled fog, and ice crystals in cold regions. The rate of precipitation of ice-fog crystals and their concentration, size, and mass distribution were measured in Fairbanks, Alaska. Ice fog occurred at temperatures of −37° C or lower only over the populated area of the city of Fairbanks, Fairbanks International Airport, and Fort Wainwright in the Tanana Valley of central Alaska. The ice-fog crystals formed at around −40° C were predominantly spherical forms of 2μ to 15μ diam, the remainder being hexagonal and columnar forms of 5μ to 30μ diam. Ice-fog crystals, supercooled fog droplets, and ice crystals were collected on electron microscope grids. After sublimation or evaporation, the residues of these specimens were examined with an electron microscope and an electron diffraction method to investigate their nucleation. These nuclei substances and their sizes were found to be very different from those of snow crystals on the Greenland Ice Cap. They were mainly combustion byproducts of 0.1μ to 3μ diam from coal- or oil-burning sources, such as powerplants and furnaces and from automobile exhausts. Even at a temperature of −40° C or lower, all ice-fog crystals examined in Fairbanks, Alaska, contained a nucleus of solid material. Author

N65-13531# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
THE PLASTIC LIMIT AS A BINARY PACKING PHENOMENON
G. E. H. Ballard Nov. 1964 27 p refs
(CRREL-152; AD-452429)

Four theoretical zones of behavior are defined from two-component particle packing theory to account for variations in Atterberg's plastic limit of the artificial clay–silt–water systems as the weight-fraction dry-clay content (X) varies from 0 to 1. From X = 0 to X = 1 the experimental plastic limit successively approaches binary packing behaviors defined by zones A, B, C, and D. Three constants of zone behavior, K the packing constant, K_s the angularity constant, and K_g the grading constant, are defined to account for the experimental deviation from the theoretical behavior. For the illite–and kaolin–silt–water systems, $K = K_s + K_g$. Author

N65-13547*# Stanford U., Calif. Stanford Electronics Labs.
THE CALCULATION OF ELECTRON DENSITY PROFILES FROM TOPSIDE IONOGRAMS USING A DIGITAL COMPUTER Technical Report No. 5
J. O. Thomas and D. Westover Aug. 1963 83 p refs
(Grant NsG-30-60)
(NASA-CR-59951; SEL-63-130) OTS: HC $3.00/MF $0.75

An ionsonde situated in a vehicle immersed in the plasma above the peak of the F2-layer of the ionosphere, measures, as a function of frequency, f, the virtual depth, h', below the vehicle, at which radio waves are reflected from the topside of the ionosphere. In this paper, a digital computer program for converting the observed, topside h' (f) curves, into electron-density profiles using the method presented by Thomas, Long, and Westover is described. The program, although designed specifically for the reduction of topside sounder records from the Alouette satellite, may also be used for the analysis of records from ground-based ionosondes. Author

N65-13615# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
STRUCTURES IN THE UPPER SNOW LAYERS OF THE SOUTHERN DOME GREENLAND ICE SHEET Research Report, 1 Jul.–7 Aug. 1960
Thomas C. Davis, Jr. Oct. 1964 32 p refs
(CRREL-Res. Rept.-115; AD-452460)

Measurements of snow accumulation, temperature, density, ram hardness, and grain size were made at 7 pit studies along 191 miles of over-snow traverse. In addition to the pit studies, 38 Rammsonde profiles were measured and 166 shallow pits were dug to measure temperature in the first meter of snow. The annual accumulation of snow was found to decrease westward, from 97-cm water equivalent 50 miles from the east coast to 40 cm 80 miles from the western margin. A possible precipitation shadow and the decrease in accumulation westward indicated that the source area for the precipitation lies to the east of the southern dome in the Greenland Sea. The study was considered to be in the percolation facies located along an east to west traverse crossing at maximum dome elevation. Author

N65-13842# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
SOIL BEHAVIOR IN A LOW AND ULTRAHIGH VACUUM
J. D. Halajian Dec. 1964 48 p refs Presented at the Ann. Meeting of the Am. Soc. of Mech. Engr., Lunar Base Session, N.Y., Dec. 1964
(RE-197J)

The behavior of simulated lunar soils is investigated by utilizing recent advances in vacuum technology and known principles of soil mechanics and surface chemistry. The effect of the gaseous and adsorbed phases on the behavior of the solid particles is evaluated in separate experiments. It is found that the absence of either phase has a hardening effect on soils. This is demonstrated by increased bearing strength of "fluff" at 10^{-3} torr, and extensive sticking of tumbling dust particles at 10^{-10} torr. The latter phenomenon is attributed to the depletion of adsorbed films. The experimental evidence favors a clean-surface rather than an electrostatic mechanism of adhesion but is not conclusive. Improved experimental techniques are suggested to overcome a number of difficulties that have hampered the quantitative measurement of soil adhesion and friction in vacuo. Author

N65-13848# Joint Publications Research Service, Washington, D.C.
ATMOSPHERIC OZONE AND JET STREAMS
G. P. Gushchin and I. A. Shatunov 6 Jan. 1965 16 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 154, 1964 p 20–29
(JPRS-28127; TT-65-30052) OTS: $1.00

The total content and the vertical distribution of ozone in relation to subtropical and extratropical jet stream axes at the 300- to 100-mb level were investigated. A considerable increase of ozone content in the left part of jet streams was observed; the form of the mean ozone profiles in the jet stream zone was found to be almost independent of season and wind direction. Vertical atmospheric turbulences were held responsible for the penetration of ozone from the mesosphere and upper stratosphere into the lower stratosphere and troposphere. G.G.

N65-13849# Joint Publications Research Service, Washington, D.C.
DETERMINATION OF SOLUBLE IMPURITIES IN ATMOSPHERIC AIR
Yu. I. Turkin and P. F. Svistov 6 Jan. 1965 10 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 154, 1964 p 99–104
(JPRS-28130; TT-65-30055) OTS: $1.00

The construction of a portable apparatus for the sampling and chemical analysis of air samples is described. The composition of gaseous microcomponents in atmospheric aerosols is determined by flame photometric spectral analysis, after these impurities are trapped in a solvent-filled absorbing tube and subsequently filtered into a distilled water manometer to obtain the proper concentration of the gaseous impurities. G.G.

N65-13877# International Council of Scientific Unions, Paris (France). World Magnetic Survey Board
WMS NOTES NO. 2
Oct. 1964 78 p refs

The minutes of the 1963 meeting of the World Magnetic Survey Board are presented. Included are several survey maps of the geographic distribution of magnetic data on worldwide basis for the years 1900 to 1962. These data were gathered by nonmagnetic ships and on airborne missions. General surveys of the various geomagnetic activities of the member nations are also included. G.G.

N65-13885# Stanford Research Inst., Menlo Park, Calif.
WHISTLERS IN A THERMAL MAGNETOSPHERE
Harold Guthart Oct. 1964 93 p refs

The nose whistler integral for cold plasmas is extended to account for finite Maxwellian electron temperatures. The nose whistler integral equation is then evaluated to determine the effect of finite electron temperatures on whistler dispersion. A comparison of the theory with whistler spectrograms reveals that the observed whistler dispersion exhibits no temperature effects. As a consequence, an upper bound on magnetosphere temperature is set at $2 \times 10^{4\circ}$ K and is an order of magnitude below a previous bound suggested by Liemohn and Scarf, based upon a cyclotron absorption hypothesis for the high frequency cutoff of nose whistlers by isotropic particle distributions. The Liemonhn and Scarf proposals for absorption of whistler energy by a variety of particle distributions are explored and found to be inconsistent with nose whistler observations. An anisotropic electron distribution is proposed which retains the original Scarf hypothesis regarding the cyclotron absorption of the high frequency components of the nose whistlers. Author

N65-13915 Joint Publications Research Service, Washington, D.C.
SOME METHODS FOR INVESTIGATING THE IONOSPHERE BY MEANS OF SPACE-DIVERSE RECEPTION OF ARTIFICIAL EARTH SATELLITE SIGNALS

L. M. Yerukhimov and N. A. Mityakov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 238–243 refs (See N65-13892 04-07) OTS: $6.00

Equations are derived in sequence for the index of refraction for quasi-longitudinal propagation, for the optical path in quasi-longitudinal propagation, and for the phase difference of ordinary and extraordinary waves of fading signals. The derivatives of the phase difference with respect to the horizontal directions x_0 and y_0 are evaluated, and the investigation of the ionosphere by the method of coherent frequencies is discussed. The relation between the derivatives of the phase difference of the coherent frequencies and the refraction angles is established, and the relation between the angles of the vertical and horizontal refraction and the partial differentials of phase difference with respect to the coordinate axes is determined for the Faraday method. D.E.W.

N65-13956# National Science Foundation, Washington, D.C.
INTERNATIONAL YEARS OF THE QUIET SUN, 1964–1965
[1964] 31 p refs
GPO: $0.20

Explained are programs being carried out by U.S. scientists as part of the IQSY. Described are the investigations concerning the sun, interplanetary medium, ionospheric physics, radio astronomy, cosmic rays and geomagnetically trapped radiation, geomagnetism, aurora, airglow, meteorology, and aeronomy. R.L.K.

N65-13964*# National Aeronautics and Space Administration, Washington, D.C.
BIBLIOGRAPHY USSR IGY WORLD DATA CENTER B1
Jan. 1965 32 p refs Transl. into ENGLISH of "Bibliograficheskiy Ukazatel' " Inst. Aeroklimatologii (USSR), no. 4, pt. 1 1960
(NASA-TT-F-92) OTS: HC $2.00/MF $0.50

N65-14035# Stanford U., Calif. Stanford Rock Magnetics Research Group
PALEOMAGNETISM OF THE MIOCENE LAVAS OF SOUTHEASTERN OREGON Final Report (Part II)
Norman D. Watkins Apr. 1964 88p refs
(Contract AF 19(604)-8043)
(AFCRL-64-97(2); AD-608938)

Ten widely separated sections of Miocene lavas in Oregon were studied. Over five hundred accurately oriented cores were drilled, from a total of 239 lavas. Their magnetic properties were measured using a spinner magnetometer, and an alternating current demagnetizing apparatus. About 8% of the lavas investigated possess reverse magnetization, and data from baked interbasaltic zones strongly support geomagnetic field variation as the source of the reverse polarity. The results support the following conclusions: (1) Secular variation of the geomagnetic field during part of the Miocene period has an amplitude similar to secular variations observed at present. (2) Using conventional assumptions, an earlier suggestion that the spin axis was apparently slightly removed from its present position during the Miocene period is supported. (3) Post-Miocene differential tectonic rotation cannot explain the relative orientations of the mean directions of natural remanent magnetism in sections featuring dual distributions. Author

N65-14043# Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.
HIGH-ALTITUDE MINIMUM-WIND FIELDS AND BALLOON APPLICATIONS Environmental Research Paper No. 64
Geoge F. Nolan and Ralland A. Smith Oct. 1964 27 p refs (AFCRL-64-843; AD-608415)

For five months the distribution of wind speeds over North America at each kilometer of altitude between 15 and 29 km was examined in terms of 10-day means and cross-sectional analyses. A relatively stable layer of minimum winds was found in the lower stratosphere between latitudes 25° N and 65° N. Within the layer there are levels where the wind speed is close to zero. Owing to the gross method of measuring upper level winds, it was not possible to confirm or refute the existence of a stable zero-wind level or layer. If it exists, however, it must be less than 4000 ft thick. The evidence from superpressure-balloon flight trajectories indicated that a minimum wind level is more probably an altitude where there are slow-moving eddies having either relatively short wavelenghts or small closed circulations. These phenomena can be utilized for balloon operations that require flights of long duration with minimum horizontal displacement from a fixed geographic location, and for high-altitude tethered-balloon operations that require float altitudes where dynamic pressure is minimum. R.L.K.

N65-14070# National Engineering Science Co., Pasadena, Calif.
WAVE SHOALING
B. J. Le Méhauté and L. M. Webb Apr. 1964 104 p refs (Contract Nonr-4177(00))
(SN-134-2; AD-603848)

The concepts of energy flux and group velocity for nonlinear periodic gravity waves are discussed. The average energy flux, average energy per wavelength, and "group velocity" are calculated for irrotational periodic gravity waves at a third order of approximation. Then the principle of conservation of transmitted energy between wave orthogonals is applied to the same order of approximation for determining the variation of wave height in decreasing depth. The results are presented as nomographs. It is seen that the "shoaling coefficient" needs to be expressed at least at a third order of approximation to account for experimental results. Author

N65-14127# American Science and Engineering, Inc., Cambridge, Mass.
THE INTERACTION BETWEEN THE SOLAR WIND AND THE EARTH'S MAGNETIC FIELD Final Report, Jan. 1962–Jan. 1964
S. Frankenthal, J. W. Carpenter, S. Olbert, J. P. Penhune, G. Siscoe et al Apr. 1964 209 p refs
(Contract AF 19(628)-270)
(AFCRL-64-433; ASE-509; AD-609216)

This report consists of a study of the interaction between the solar wind and the earth's magnetic field, which takes into account the presence of an interplanetary magnetic field within the solar wind and the possibility that the solar wind may be penetrated by field lines emanating from the earth. A qualitative discussion is presented of the field and flow patterns which may develop under the conditions stated above. The model emerging from this discussion is an extension of earlier models and includes the effect of current-carrying MHD discontinuities. This model is reconciled with the Axford–Hines model for circulation of plasma within the cavity, which provides an explanation for auroral phenomena but has not been verified by direct measurements. It is also correlated with available experimental information. Also, two methods for the treatment of the MHD equations are explored. Author

N65-14161# Joint Publications Research Service, Washington, D.C.
EXPERIENCE USING PILOT BALLOONS WITH A SUSPENDED BASE
I. I. Chestnaya 6 Jan. 1965 13 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 154, 1964 p 78–84
(JPRS-28132; TT-65-30057) OTS: $1.00

The suspended base is a cable to which marks are attached as definite, precisely measured distances from the balloon. The base is carried aloft by the balloon, and its length is the principal parameter for computing the withdrawal distance of a balloon from the launching site. For this measurement, a special angle-measuring grid is inserted into the eyepiece of the theodolite. The grid is a series of concentric circles of different radii corresponding to the different angular dimensions of the viewed object. Methods of computation using the angle-measuring grid are discussed. Experiments using the suspended base method are described, and results are compared with the conventional single-station observations. E.K.R.

N65-14166# Joint Publications Research Service, Washington, D.C.
STRUCTURE OF THE BOUNDARY LAYER OF THE ATMOSPHERE AT DIFFERENT LATITUDES
D. L. Laykhtman and L. R. Orlenko 11 Jan. 1965 11 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 150, 1964 p 14–20
(JPRS-28218; TT-65-30099) OTS: $1.00

This article derives formulas and cites the results of computations of the principal characteristics of the boundary layer at different latitudes. It includes an analysis of patterns noted in the investigation. Author

N65-14167# Joint Publications Research Service, Washington, D.C.
VERTICAL TURBULENT EXCHANGE IN THE ATMOSPHERIC SURFACE LAYER
S. S. Zilitinkevich 11 Jan. 1965 24 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 150, 1964 p 21–35
(JPRS-28219; TT-65-30100) OTS: $1.00

This article discusses the theory of vertical turbulent mixing in the surface layer of the atmosphere. It contains the principal results of investigations of this phenomenon for equilibrium and nonequilibrium stratified flow. Relationships characterizing the effect of a nonstationary state and of horizontal nonuniformity of flow are given. Author

N65-14170# Library of Congress, Washington, D.C. Aerospace Technology Div.
PHENOMENA IN THE UPPER ATMOSPHERE. COMPILATION OF ABSTRACTS
9 Dec. 1964 26 p refs *Its* Rept.-49
(ATD-P-64-65)

Soviet studies on the following topics are abstracted: *Solar Radiation and the Ionosphere*; *Van Allen Belts and Cosmic Rays*; and *Satellite and Missile Data*. G.G.

N65-14202# Defense Research Corp., Santa Barbara, Calif.
STUDY AND INVESTIGATION OF THE PROPAGATION OF WHISTLER MODES THROUGH THE IONOSPHERE Final Report
B. A. Lippmann, Philip J. Wyatt, and Victor A. Erma Griffiss AFB, N.Y., RADC, Sep. 1964 204 p refs
(Contract AF 30(602)-3082)
(RADC-TDR-64-283; AD-609127)

Described is an analysis of the effects that the atmosphere imposes on whistler propagation. The subjects of concern were absorption, scattering and reflection losses in the D- and E-region of the ionosphere, and the physical nature of columns of enhanced ionization which support this type of propagation. A model was derived which represented the electron density and the electron ion-neutral collisional frequencies in the ionosphere. These parameters were evaluated in a computer system, and the results agreed with those obtained in the Lofti-I experimental program. Another model was initiated which represented the columns of enhanced ionization in the atmosphere. A series of complex electromagnetic field equations were set up and solved in a digital computer. The results showed that whistlers propagate in the ducts as well as between them. Also, the enhancement of the ducts relative to their surroundings can be as little as 0.05% in order to support whistler propagation. Although these two findings were postulated before by others in the whistler field, no one has previously mathematically formulated the problem. Author

N65-14278# Stanford Research Inst., Menlo Park, Calif.
WHISTLERS IN A THERMAL MAGNETOSPHERE
Harold Guthart Oct. 1964 92 p refs

The nose whistler integral for cold plasmas is extended to account for finite Maxwellian electron temperatures. The nose whistler integral equation is then evaluated to determine the effect of finite electron temperatures on whistler dispersion. A comparison of the theory with whistler spectrograms reveals that the observed whistler dispersion exhibits no temperature effects. As a consequence, an upper bound on magnetosphere temperature is set at $2 \times 10^{4\circ}$ K. The temperature bound of $2 \times 10^{4\circ}$ K is an order of magnitude below a previous bound suggested by Liemohn and Scarf based upon a cyclotron absorption hypothesis for the high frequency cutoff of nose whistlers by isotropic particle distributions. The Liemohn and Scarf proposals for absorption of whistler energy by a variety of particle distributions are explored and found to be inconsistent with nose whistler observations. Finally, an anisotropic electron distribution is proposed that retains the original Scarf hypothesis regarding the cyclotron absorption of the high frequency components of the nose whistlers. At the same time, this distribution is consistent with the dispersion characteristics of whistlers as well as with the observations of whistler-triggered vlf emissions. The distribution consists of an ambient Maxwellian plasma plus a tenuous, streaming, Maxwellian plasma. Author

N65-14317# Naval Research Lab., Washington, D.C. Solid State Div.
THE INTERPRETATION OF INFRARED RADIATION FROM THE SEA IN TERMS OF ITS BOUNDARY LAYER
M. F. M. Osborne 16 Sep. 1963 22 p refs
(NRL-5977; AD-428543)

By writing down the heat balance due to radiation, conduction, and evaporation at the sea surface, the radiation temperature of the sea surface can be expressed as a linear function with known coefficients of two variables: the water boundary-layer thickness δ_w, and the ratio of water to air boundary-layer thickness δ_w/δ_a. Under the assumption that these two variables can be described by laminar flow for short distance (< 10 cm) and small intervals (< 1 sec), the conditions for optimum observation of detailed structure in the sea surface temperature can be derived. These are clear

sky, dry air, and, especially, an appreciable wind. Calculations were made of the small changes in the radiation temperature of the sea produced by mean air velocity changes of 1 cm/sec and mean water velocity changes of 1 mm/sec. A number of predictions were made concerning the temperature patterns to be observed around known velocity patterns in the air and water. Author

N65-14347# California U., La Jolla. Inst. of Geophysics and Planetary Physics
STUDY OF EARTH NOISE ON LAND AND SEA BOTTOM Final Report
Hugh Bradner, Richard A. Haubrich, and Walter H. Munk 10 Sep. 1964 194 p refs
(Grant AF-AFOSR-62-420; ARPA Order 292-62)
(AD-450331)

Discussed are the following: the statistical properties of microseisms on land, microseisms in the band 5 to 200 millicycles per second, station arrays, ocean bottom measurements of seismic waves, reliability of the measurements, and types of seismic waves, and the sources of microseisms. D.E.W

N65-14351# Stanford U., Calif. Radioscience Lab.
PHASE HEIGHT OSCILLATIONS IN THE IONOSPHERE Technical Report No. 7 and Technical Report No. 95
Theodore M. Watt Apr. 1964 42 p refs
(Grant NsG-30-60; Contract Nonr-225(64); ARPA Order 196-63)
(SU-SEL-64-061; AD-450432)

The primary purpose of the experiment was to look for correlation between ionospheric phase height fluctuations and long period magnetic micropulsations with the thought that this correlation might be interpreted either in terms of hydromagnetic waves or as drift motions produced by E-region currents. Atmospheric pressure fluctuations were also recorded for possible correlation studies. The experimental equipment, techniques, and parameters are described. The data are compared in three ways: (1) phase height—micropulsations; (2) phase height—atmospheric pressure; and (3) ordinary wave—extraordinary wave phase height. Author

N65-14380# Atmospheric Research Group, Altadena, Calif.
THE EFFECTS OF WIND AND PRECIPITATION ON THE MODIFICATION OF SOUTH BEACH, CRESENT CITY, CALIFORNIA Final Report
James A. Robert and Erwin K. Kauper 14 Oct. 1964 64 p refs
(Contract DA-49-092-ARO-38)
(ARG64-FR-186; AD-607944)

During the night of 27–28 March 1964, a tsunami of destructive force struck the Crescent City area of northwestern California. The configuration of South Beach, which is located southeast of the Crescent City harbor, was changed significantly by the waves and by subsequent beach cleanup. The modified beach affords an excellent opportunity for analysis of the effects of subaerial processes on the formation of a beach. Prior to the direct and indirect results of the tsunami, South Beach had a heavy cover of driftwood which was completely cleared after the tsunami. Meteorological and sand survey instruments were installed to monitor subsequent beach developments. From 26 April to 15 September the most significant change was the growth of a low berm seaward of the existing berm. This development may be the indirect result of the wind acting via a littoral current. Small-scale direct wind effects were observed in ripple development and movement. Additional studies are required to confirm the effects of the subaerial processes on the shaping of South Beach. Author

N65-14392# Joint Publications Research Service, Washington, D.C.
JET STREAM TURBULENCE DURING SHEAR OF THE GEOSTROPHIC WIND
D. L. Laykhtman and E. K. Byutner 11 Jan. 1965 10 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 150, 1964 p 63–68
(JPRS-28220; TT-65-30101) OTS: $1.00

A nomogram for determining the turbulence coefficient in a jet stream during shearing of the geostrophic wind was constructed. Dynamic and thermal factors in energy fluctuations are obtained through a balance equation for measuring temperature distribution in the jet stream. Resulting computations on the combined characteristics of turbulence and shearing made a more precise determination of turbulence parameters possible for both the upper and lower parts of the jet stream. M.G.J.

N65-14425# Defence Research Board, Ottawa (Canada).
SOME LAWS EXHIBITED BY GEOMAGNETIC BAYS IN THE MIDDLE LATITUDES
L. L. Van'yan and Ye. P. Kharin Aug. 1964 7 p refs Transl. into ENGLISH from Geol. i Geofiz., Akad. Nauk SSSR, Sibirsk. Otd. (Novosibirsk), v. 9, 1963 p 125–129
(T-404-R; AD-607433)

To determine some features of the variable magnetic field produced by electric currents in the middle latitudes, the current layer was replaced by an equivalent linear current at a distance of 1500 to 2000 km. Electronic computer calculations showed the following properties for the magnetic field of bay disturbances in the remote zone: (1) The horizontal component fell off in inverse ratio to the square of the distance from the auroral zone, while the vertical component fell off in inverse ratio to the cube of that distance. (2) The frequency spectra did not change with distance from the auroral zone. (3) The ratio of the vertical to the horizontal component diminished linearly with distance and was not dependent on height. Latitude variations of bay disturbance intensities were experimentally verified by quantitative evaluations, using magnetograms of bays observed at several locations. M.G.J.

N65-14428*# Consultants and Designers, Inc., Arlington, Va.
GEOMAGNETIC ECCENTRIC DIPOLE [GEMAGNITNYY EKSTSENTRICHNYY DIPOL']
N. P. Ben'kova, T. L. Vinnikova, and L. O. Tyurmina 17 Dec. 1964 12 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 5, 1964 p 917–923
(Contract NAS5-3760)
(NASA-TT-F-9612; ST-GM-10261) OTS: HC $1.00/MF $0.50

The parameters of the eccentric dipole and the points of intersection of its axis with the earth's surface are computed on the basis of the world magnetic charts for the 1955 epoch. Simple formulas are derived for the computation of the eccentric-dipole field. The values of the field, computed by these formulas at various heights, are compared with the field of the central dipole and with the results of synthesis of spherical harmonic series. A conclusion is derived on the possibility of utilizing the eccentric-dipole model for the estimate of the field at great heights. Author

N65-14435# Army Natick Labs., Mass. Earth Sciences Div.
CANAL ZONE ENVIRONMENT—PACIFIC SECTOR
Robert L. Anstey Aug. 1964 76 p refs
(ES-12; AD-450724)

The Pacific Sector, Canal Zone, contains numerous areas for testing or training in tropical environments under the political jurisdiction of the United States. The climate of this area is tropically wet and dry, typical of savanna areas. Seasonal differences in climate are significant in testing program results. Vegetation consists primarily of tropical deciduous forests on the uplands and marsh plants or swamp on the lowlands. Dense vegetation tends to grow in forest clearings. Inland, the landscape consists of numerous low rounded hills; coastal benches and terraces are fringed by wide mud flats exposed only at low tide. Representative savanna areas may be found in the Rio Hato Military Reservation, 64 miles west of the Canal Zone in the Republic of Panama. Author

N65-14442 AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
ANTARCTIC RESEARCH AND DATA ANALYSIS—A PROTON-COLLISION MECHANISM FOR THE PRODUCTION OF SPREAD F IRREGULARITIES Scientific Report No. 16
John R. Herman 24 Aug. 1964 15 p refs
(Contract NSF C-255)
(RAD-TR-64-27; AD-606400)

It is well known that the spread echoes observed on Arctic and Antarctic ionograms arise from reflections or scattering from irregularities in the F-region. This report attempts to explain the formation mechanism for such irregularities. The assumption is made that field-aligned irregularities are caused by low-energy ($\leq$ 20 keV) charged particles spiralling along magnetic field lines and penetrating to F-region heights. Ionization is created along the field lines by collisions, and it remains field aligned due to the effects of diffusion. It is suggested that this mechanism is operative at all times but with some variation in intensity. During daytime, the irregularities produced in this manner are usually masked by higher electron densities given by photoionization. Supporting evidence for the proposed production mechanism is given by the diurnal, seasonal, and geographical variations in spread-F occurrence and its correlation with magnetic activity. Author

N65-14469# Alaska U., College. Geophysical Inst.
CATALOGUE OF HUET AURORAL SPECTRA, 1957–1963 Scientific Report No. 2
Gerald J. Romick Sep. 1963 65 p refs
(Contract Nonr-1289(00))
(UAG-R142; AD-423333)

The zenith auroral spectra at College, Alaska, which were obtained during the six observing seasons from the fall of 1957 through the spring of 1963 were assembled into catalog form. The prime purpose of this catalog is to present the auroral activity in a manner which can be used by others in the interpretation of aurorally associated phenomena. From the general appearance of the spectra and other factors, a table of daily activity index numbers (1–9) is given for each observing period. The monthly averages of these index numbers were plotted for this entire period and were compared with various indices of solar and geomagnetic activity. An anomalous increase in the auroral activity index in the fall of 1962 destroys an otherwise perfect trend in the relation of the auroral activity to the decline in the sunspot cycle. It is suggested that a more detailed investigation of both solar and geomagnetic variations is warranted in order to assess the relative contribution of natural and manmade events in producing this anomalous effect. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-13505# Bendix Corp., Southfield, Mich. Research Labs. Div.
DEVELOPMENT OF A HYPSOMETER FOR ATMOSPHERIC SOUNDING Final Engineering Report
W. G. Wolber Apr. 1964 44 p
(Contract DA-36-039-SC-84992)
(RLD-2601; AD-607373) OTS: $3.00

The summarized program resulted in the development of a miniature hypsometer for rocketborne dropsonde application. The developed unit met or exceeded the contract specifications. The sensing technique, the sensor's design and development, the laboratory performance tests, the actual rocket flight tests, and the development of a pressure calibration stand are discussed. Author

N65-13543*# Ryan Electronics, San Diego, Calif.
RYAN MODEL 520 RADAR ALTIMETER Final Engineering Report
N. L. Olthoff and H. T. Hoffman 15 Oct. 1964 59 p *Its* Rept.-52067-2
(Contract NAS8-2459)
(NASA-CR-59893) OTS: HC $3.00/MF $0.50

The fabrication and delivery of four altitude-measuring radar sets are described. The radar altimeters were identical to those delivered under the original contract except for the following modifications: The timer subassembly provides an elapsed time interval counter with a capacity of 16 bits and a time resolution of 1/36 of a second; and an external reset capability is provided in the elapsed time interval accumulator. D.E.W.

N65-13559*# Princeton U., N.J.
MODULATED LIGHT METHODS IN POLARIZED LIGHT AND INTERFERENCE MICROSCOPY
Robert D. Allen [1964] 13 p Presented to the Intern. Soc. for Cell Biol., Brown Univ., Providence, 4 Sep. 1964
(Contract NASr-159)
(NASA-CR-58976) OTS: HC $1.00/MF $0.50

An universal birefringence measuring microscope is described that contains a potassium dideuterium phosphate crystal as an electro-optical light modulator (EOLM). The crystal becomes birefringent when a voltage is applied to its surfaces. The induced birefringence is of a strictly linear nature and known wavelength. This system permits the encoding and registration of a selected optical property and can be used for point measurements, one- or two-dimensional image scans, measurements at one or more points in the image through time, and spectral scans. Through the addition of a second EOLM system and two lock-in amplifiers at different frequencies, the rotation and birefringence can be measured independently from one another. This will increase the precision and speed in interference microscopy, and will be very useful in cell biology studies. G.G.

N65-13571# American Meteorological Society, Boston, Mass.
DEVICE FOR MEASURING THE SIZE SPECTRUM OF SPHERICAL PARTICLES AND FOG DROPLETS [USTANOVKA DLIA IZMERENIIA SPEKTRA RAZMEROV SFERICHESKIKH CHASTITS I KAPEL' TUMANOV]
V. I. Golikov Bedford, Mass., AFCRL, Jan. 1964 24 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 109, 1961 p 76–89
(Contract AF 19(628)-3880)
(T-R-422; AD-602187)

Described is a laboratory device for measuring the size spectrum of spherical particles of powder (plane models of sol) and water droplets (droplets in a thin oil film, and a steam fog in the cloud chamber of the Main Geophysical Observatory), and investigating possible sources of error and means of reducing them. Author

N65-13612 Jet Propulsion Lab., Calif. Inst. of Tech. Pasadena.
RADIAL STRESS MEASUREMENTS IN PROPELLANT GRAINS
Anthony San Miguel and Robert H. Silver *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 607–623 refs (See N65-13577 04-34)
(ARPA Order 107-62)

The first miniature, directional stress transducer was developed, constructed, and evaluated. The transducer is a device that measures a directional force being experienced within a deformed material, such as a pressurized solid-propellant motor. This transducer is 0.100 in. long and 0.046 in. in diameter. The active element is a piezoresistive p-type silicon splinter. A 2-mil lead wire transmits signals from the transducer to recording equipment. Complete information is presented regarding the transducer construction. Nonlinearity problems are discussed both from the point of view of the circuitry and of the piezoresistance. The transducer was used to measure a radial stress in a propellant grain. Casting techniques for calibrating and embedding the transducer are described. Finally, transducer response vs grain pressurization is compared with theoretical predictions of radial stress. Author

N65-13617# Northrop Corp., Hawthorne, Calif. Northrop Space Labs.
RESEARCH ON X-15 BACKGROUND MEASUREMENTS
Interim Engineering Report
R. H. Bingham 1 Oct. 1964 19 p
(Contract AF 33(615)-1566)
(AD-450652)

Described are the optical, mechanical, and electronic circuitry changes necessary to modify an X-15 mounted uv spectrometer to cover the spectral range 1.3μ to 0.3μ with an instantaneous bandwidth no greater than 20 Å at 1.3μ, and 5 Å at 0.3μ. The instrument was an uv spectrometer originally designed to operate in the range from 0.2μ to 0.3μ. Since only one grating was to be employed, it was necessary that energy in two overlapping orders be measured, thus requiring order sorting by some means. The order-sorting device selected was a pair of dichroic mirrors which would transmit the first order to two photodetectors sensitive in the longer wavelength region of interest and would reflect the second order to a photomultiplier tube. In order to match the time constants for the required spectral resolution, it was necessary to slow down the scan rate so that the spectrum was scanned in 5 seconds compared to 1 second for the scan rate of the original instrument. R.L.K.

N65-13621# ARO, Inc., Arnold Air Force Station, Tenn. Experimental Research Group
AUTOMATIC LANGMUIR PROBE EVALUATION OF ION BEAMS
R. H. Hines Arnold Eng. Develop. Center, Dec. 1964 38 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-128; AD-453422)

An electronic system to automatically scan the voltage range required to effect Langmuir probe measurements was designed and built. The unit is to be used as a diagnostic tool for long-term ground testing of electrical propulsion engines. Design details, operational analysis, and preliminary results of several experimental runs taken of an arc-ion exhaust are presented. Author

N65-13793# ARO, Inc., Arnold Air Force Station, Tenn.
A LOW-LOAD THREE-COMPONENT FORCE BALANCE FOR MEASUREMENTS IN A LOW-DENSITY WIND TUNNEL
George D. Arney, Jr. and Wade T. Harter Arnold Eng. Develop. Center, Dec. 1964 25 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-280; AD-453130)

This paper describes a three-component force balance which has been developed for measurement of lift, drag, and pitching moment acting on models in a low-density, hypervelocity wind tunnel. Although designed for a particular wind tunnel, the general arrangement and the principles involved should be applicable to similar situations. The balance is of the external type operating on the nulling principle. Nulling of each component is accomplished automatically through the use of closed loop control systems. Calibration data and sample wind-tunnel measurements are presented which demonstrate that the balance is suitable for the intended application. Author

N65-13803# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
A CALORIMETER FOR MEASURING THE LOW TEMPERATURE HEMISPHERICAL EMISSIVITY OF METALLIC AND CERAMIC SURFACES
Aug. 1964 9 p refs
(ML-TDR-64-223; AD-607209)

An apparatus was designed, constructed, and calibrated for the measurement of the hemispherical emissivity of metallic and ceramic surfaces at temperatures down to 60° K. The technique is based upon the measurement of the rate of evaporation of liquid helium to determine the heat flux. Accuracy of the apparatus was determined to be ±3% based upon a calibration using known heat inputs. Data are presented for an aluminum honeycomb structure and alumina. Author

N65-13826*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
APPARATUS FOR MEASURING EMITTANCE AND ABSORPTANCE AND RESULTS FOR SELECTED MATERIALS
Henry B. Curtis and Ted W. Nyland Washington, NASA, Jan. 1965 22 p refs
(NASA-TN-D-2583) OTS: HC $1.00/MF $0.50

An apparatus for measuring hemispherical total emittance and normal solar absorptance is described. A steady-state heat balance method is used in making measurements at specimen temperatures between 280° and 600° K. A carbon-arc solar simulator that is used in the absorptance measurements is described. A description of a blackbody normal absorptance

standard is given. Results are given for the following surfaces: four plasma-sprayed ceramics—zirconium silicate, strontium titanate, calcium titanate, and barium titanate; two ceramics, applied by the Rokide process—Rokide MA and Rokide ZS; anodized aluminum, uncoated and electrophoretically blackened; and a white epoxy-based paint. The accuracy of the apparatus is discussed. Author

N65-13852# Iowa State U. of Science and Tech., Ames. Ames Lab.
Au Fe vs Cu THERMOCOUPLES
D. K. Finnemore, J. E. Ostenson, and T. F. Stromberg Nov. 1964 11 p refs
(Contract W-7405-ENG-82)
(IS-1046)

Gold doped with a few hundredths of a percent Fe provides very satisfactory thermocouple elements at low temperatures. The temperatures from Au–Fe wires were determined in a constant volume gas bulb made of pure copper and containing a central copper rod encasing a vapor pressure bulb. This constant volume gas thermometer had an equilibrium hydrogen temperature of 20.253 ±0.03° K at a saturated vapor pressure of 760.00 torr. The results of Au 0.07 at%Fe measurements using this device are presented in a linear curve for the temperature range from 6 to 20° K and show a stable sensitivity between 13.5 and 14.0μV/° K. Even at 78° K, the sensitivity falls only to 8μV/° K. It is concluded that Au–Fe thermocouples provide a quick, easy and reliable method for accurate temperature observations in the range from 4.2 to 20° K. G.G.

N65-13859*# Bendix Corp., Southfield, Mich. Research Labs. Div.
DESIGN, DEVELOPMENT AND PROTOTYPE FABRICATION OF AN AREA HYDROGEN DETECTOR Summary Report, 5 Apr. 1963–4 Apr. 1964
P. A. Michaels Sep. 1964 93 p ref *Its* Rept. No. 2573
(Contract NAS8-5282)
(NASA-CR-59975) OTS: HC $3.00/MC $0.75

Described are the design and performance of a miniature area hydrogen detector for use in the unpressurized sections of large rocket booster and sustainer stages. The detector employs a hydrogen sensor element, consisting of a thin palladium film deposited on a glass substrate, in a specially designed support assembly. It provides optimum gas sensing at both sea level pressure environments and those encountered in interplanetary space vehicles. Installation and maintenance procedures are given. R.L.K.

N65-13876# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
ANALYSIS OF CONTROL-DISPLAY LIMITATIONS IN MULTI-JET TRANSPORT AIRCRAFT
James P. Eri and Paul E. Blatt (M.S. Thesis) Jun. 1964 287 p refs
(GGC/EE/64-4; AD-604065) OTS: $7.00

The methodology derived by Kearns and Ritchie was applied to the control-display subsystem design for a class of heavy logistic transports expected to be operational in the 1970 time period. A long-range mission was investigated in detail by analytical techniques, leading to a logical progression of sensors, computers, displays, and controls required for the vehicle. Stringent mission requirements included all-weather aerial delivery and landing, low-level terrain avoidance, and laminar-flow control. Some of the control-display innovations evolving from the study are (1) an advanced integrated instrument system with throttle command indicator, (2) vertical scale engine instruments featuring thrust displays, (3) combined mode selector and automatic flight-control-system controller with integral flight director computer, (4) integrated comm–nav selector, (5) vertical path computer, (6) cruise control, and (7) flight plan viewer display. Author

N65-13906 Joint Publications Research Service, Washington, D.C.
SENSITIVITY OF A RADIOMETER CONTAINING A SYSTEM WITH VARIABLE PARAMETERS
V. A. Markelov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 152–157 refs (See N65-13892 04-07) OTS: $6.00

With the cancellation or modulation method of noise-signal reception, the threshold sensitivity of equipment containing a system with variable parameters will be poorer than in the case in which an ordinary type of system is used, where the noise factors and pass bands are the same. Author

N65-13922# Institute of Electrical and Electronics Engineers, New York, N.Y.
PROCEEDINGS OF THE 1ST INTERNATIONAL CONGRESS ON INSTRUMENTATION IN AEROSPACE SIMULATION FACILITIES
[1964] 413 p refs Congr. Held at l'Ecole Nationale Superiéure de l'Aeronautique, Paris, 28–29 Sep. 1964; Sponsored by IEEE/PTGAS

Miscellaneous papers on instrumentation and related technology in the aerospace field. For titles of individual papers see N65-13923 through N65-13950.

N65-13923 General Electric Co., King of Prussia, Pa. Space Sciences Lab.
RADIATION TRANSFER EQUATIONS AND PHOTOGRAPHIC TECHNIQUES IN HYPERSONIC RE-ENTRY EXPERIMENTS
Andrew Guttman *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 14 p refs (See N65-13922 04-14)
(Contract AF 04(694)-499)

Radiation transfer equations applicable to various types of imaging instruments used against distant sources are presented. Emphasis is placed on measurements against point and line radiators with instruments yielding image spectra. Framing and streaking cameras are discussed in terms of the overall transfer functions of the instrument and sensor. Calibration techniques used for absolute intensity measurements are shown to yield data within a factor of two of the actual value in most cases. The instruments described are of specific use in optical radiometry against bodies penetrating the earth's atmosphere in the hypervelocity regime, and are equally applicable to measurements in a ballistic range. Imaging instruments are preferred to point detector devices in order to facilitate the problem of tracking these fast-moving objects. Author

N65-13924 Naval Ordnance Lab., White Oak, Md.
PROJECTILE DETECTION OF LUMINOUS AND NONLUMINOUS BODIES IN A LARGE HYPERBALLISTICS RANGE
E. L. White and J. N. Fedenia *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 23 p refs (See N65-13922 04-14)

In a large hyperballistics range, detection of hypervelocity projectiles at instrumented stations becomes more complex. The length of the range permits a greater variation of projectile

luminosity conditions and requires a greater area for projectile detection. A technique was devised, using the electro-optical method, of triggering instrumented stations automatically with either luminous or nonluminous projectiles. The phototube circuit response characteristics, effect of projectile velocity, and effect of light screen thickness on performance are discussed. Data on projectile detection performance are presented for projectile velocities of 10 000 to 21 000 fps. Performance is predicted for projectile velocities of 40 000 and 60 000 fps. This system has performed reliably for both luminous and nonluminous projectiles. Nonluminous models as small as 3/16-inch diameter spheres have been detected at a velocity of 21 000 fps. Author

N65-13925 Institut Franco-Allemand de Recherches, St. Louis (France).

CAMERAS FOR PHOTOGRAPHY OF MISSILES IN HYPERSONIC FLIGHT [CAMERAS POUR PHOTOGRAPHIE DES PROJECTILES EN VOL HYPERSONIQUE]

M. Paques and M. Lecomte *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 9 p refs in FRENCH (See N65-13922 04-14)

The use of cameras to record the velocity and incidence of models in hypersonic flight, as well as the form and position of the shock wave, the effects of ablation, and the wake, is discussed. The cameras used are spark cameras for shadow photography; a camera that compensates for the speed of the model by means of an interior rotating mirror for shadow and clear light photography; and an experimental electronic shutter camera for clear light. Densitometric measurements are made on the obtained films. The diffraction and the lack of field depth impose a minimum dimension on the spread function of an image point, no matter what adjustment or type of camera is used. Errors due to displacement of the projectile, errors in the operations, and errors due to the film and the analysis method are discussed. The principal relations are given that permit evaluation of the actual spread function for a given case. M.P.G.

N65-13926 Aberdeen Proving Ground, Md. Exterior Ballistic Lab.

INTERFEROMETERS FOR HYPERVELOCITY RANGES

Robert L. Rowe *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 14 p refs (See N65-13922 04-14)

The design of a horizontal plate Mach–Zehnder interferometer for use inside the vacuum of hypervelocity ranges is discussed along with adjustment procedures and kinesthetically operated remote controls for this and other such interferometers. The problem of high-speed photography connected with Mach–Zehnder interferometers when used with high velocity free-flight models is touched upon. A two-color attachment for the measurement of electron densities with interferometers is described. A single-color interferogram of a Mach 10 sphere in air at 75 mm is presented along with its tentative isopycnal diagram. Author

N65-13927 Lincoln Lab., Mass. Inst. of Tech., Lexington.

SOME INSTRUMENTATION TECHNIQUES USED AT THE RE-ENTRY SIMULATING RANGE

R. E. Slattery and W. G. Clay *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 16 p refs Supported by ARPA (See N65-13922 04-14)

Schlieren optics and uhf cavities are used to gather data on the wakes of hypervelocity projectiles. Evacuating most of the schlieren optical path and development of a stable-line spark source have contributed to increased sensitivity and resolution in the study of the gaseous wake. Data reduction methods were developed in the examination of the statistics of wake turbulence. The cavity technique provides data on the electronic wake over several orders of magnitude in electron density and wake distances. Author

N65-13928 Institut Franco-Allemand de Recherches, St. Louis (France).

SOUNDING OF PLASMAS THROUGH IMPEDANCE MEASUREMENTS [SONDAGE DES PLASMAS PAR DES MESURES D'IMPEDANCE]

M. Laug and P. Clavelin *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 8 p refs In FRENCH; ENGLISH summary (See N65-13922 04-14)

The ionized wakes of hypervelocity pellets are investigated by the resonant cavity method (TM_{010}, 250 Mc/sec). The input admittance of the cavity is measured with a four-probe admittance meter, providing a XY-trace together with a SMITH chart on an oscilloscope CRT. Two methods are suggested to make the measurement time resolved. From the two measured parameters (real and imaginary part of the admittance), the plasma parameters (total number N of electrons within the cavity and electron collision frequency ν) are deduced, owing to an energy perturbation theory, which is described. Discussions are included about accuracy, calibration methods and limitations. The same apparatus is used to probe shock-ionized air in a coaxial shock-tube. The propagation of 250 Mc/sec waves is studied by this way. Author

N65-13929 General Motors Corp., Santa Barbara, Calif. Defense Research Labs.

MILLIMETER RADAR INSTRUMENTATION FOR STUDYING PLASMA EFFECTS ASSOCIATED WITH HYPERSONIC FLIGHT

H. M. Musal, Jr., R. I. Primich, W. E. Blore, and P. E. Robillard *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 13 p refs (See N65-13922 04-14)

(Contract DA-04-495-ORD-3567(Z); Proj. Defender)

Millimeter wavelength radars are used to study the plasma effects associated with the ionized flow fields of projectiles launched at hypersonic speeds into a free-flight ballistic range. Two cw doppler radars, which operate at frequencies of 35 and 70 Gc, are used to measure the nose-on backscattering radar cross sections of projectiles during their flight. The design and performance of the two radars, which operate simultaneously through a wire-grid beam splitter, are described in detail. A doppler signal simulator provides absolute calibration of each radar so that the dynamic radar cross section of the projectile in flight can be measured to within ±one decibel. The purpose of this millimeter radar instrumentation is to measure the changes that occur in the radar cross sections of hypersonic projectiles caused by their highly ionized flow fields. The details of the radar cross-section changes are intimately related to the spatial distribution of ionization in the bow-shock region. Comparisons between theoretical predictions and experimental data show good correlation. Author

N65-13931 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

MEASUREMENT OF FORCES IN AN ARC WIND TUNNEL BY A PIEZOELECTRIC BALANCE WITH THREE INERTIALLY COMPENSATED COMPONENTS [MESURE DES EFFORTS DANS ONE SOUFFLERIE A ARC PAR UNE BALANCE PIEZOELECTRIQUE A TROIS COMPOSANTES COMPANSEE EN INERTIE]

Jean Berry and Roland Hoarau *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 7 p refs In FRENCH (See N65-13922 04-14)

The described piezoelectric balance compensates for inertia by placing, in the neighborhood of each dynamometer, an accelerometer furnishing a signal proportional to accelerations of the model. The signals from the three accelerometers affected by the appropriate coefficients are subtracted from the signals of the dynamometers to obtain the signals due to the aerodynamic forces. Besides the description of the balance and its operation, the procedures for determining the coefficients of compensation, the diagram of the analog calculator used for the compensation, calibrations, and results are discussed. M.P.G.

N65-13932 Martin Co., Baltimore, Md.
WIND TUNNEL MEASUREMENT OF LAUNCH VEHICLE RANDOM BUFFET EXCITATION USING AN INERTIA COMPENSATED BALANCE TECHNIQUE
C. V. Stahle, C. G. Stouffer, and W. Silver *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 11 p refs (See N65-13922 04-14)

A simplified technique for measurement of launch vehicle random buffet excitation is presented which uses a rigid model of the forward portion of the vehicle. The technique combines the signals from a standard two-point moment balance with the signals from two strategically located accelerometers to provide an inertia-compensated measurement of the aerodynamic moment at two points on the model. By proper design of the model and balance, the forward accelerometer will completely compensate for the inertia effects at the forward balance location, and the aft accelerometer will compensate for the inertia effects of the first three model-sting modes at the aft balance location. For the frequency range usually investigated, this provides adequate compensation of the model inertia effects permitting the moment of unsteady aerodynamic forces to be measured by the inertia compensated balance.
Author

N65-13934 Aberdeen Proving Ground, Md. Ballistic Research Labs.
WIND TUNNEL TESTS OF SOLID STATE STRAIN GAGES
A. S. Platou and H. A. Ricci *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 15 p refs (See N65-13922 04-14)

Investigations were conducted on the use of solid-state or semiconductor strain gages to increase the accuracy, range, and/or stiffness of wind-tunnel balances and pressure transducers. One of the main objectives is to improve the measuring accuracy of Magnus forces and moments acting on spinning projectiles. Semiconductor strain gages have gage factors 30 to 100 times larger than wire-wound strain gages, so that increased sensitivities and accuracies are possible. It is now possible to temperature compensate these gages so that they respond only to strain. The temperature compensation, the calibration, and the use of this balance system for measuring the Magnus moments on a spinning projectile are described. It is shown that satisfactory, reliable, and repeatable Magnus data can be obtained using this balance system. Author

N65-13938 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MEASUREMENT OF PRESSURES AND HEAT TRANSFER BY FM TELEMETRY FROM FREE-FLYING MODELS IN HYPERSONIC TUNNEL STREAMS
John B. Mc Devitt, Dean R. Harrison, and William K. Lockman *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 12 p refs (See N65-13922 04-14)

A measurement system is described for obtaining pressure and heat-transfer data from models released to fly freely in hypersonic tunnel streams. The test models are either released from suspension threads or launched by low-velocity pneumatic launchers and have miniaturized frequency-modulated telemetry units mounted within. This technique permits the historically desired measurement of support-free afterbody pressure and heat-transfer rates. The procedures and instrumentation required to obtain measurements in a low-enthalpy hypersonic helium stream, and in a hypersonic shock tunnel using air at a stagnation ethalpy of 4600 Btu/lb, and useful running times up to 20 milliseconds, are described. Base heating and pressure measurements for a cone and a sphere in free flight are included to illustrate the practical application of the present system for conducting aerodynamic research. The use of blunt test models in the high-enthalpy shock tunnel required special shielding techniques for minimizing electrical coupling between the plasma in the bow shock layer and the telemeter unit. Author

N65-13943 Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.
THE USE OF MASS-FLOW AND TOTAL-ENTHALPY PROBES IN SUPERSONIC FLOW
Alan C. Brown, C. Edward Smith, Jr., Raymond L. Kramer, and Edward E. Mc Adams, Jr. *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 11 p refs (See N65-13922 04-14)

Measurements of Pitot-pressure profiles behind a hypersonic body are not sufficient to define the flow properties, especially in the viscous wake where the flow is nonadiabatic. Consequently two probes are being developed for measuring time-resolved gas properties in a short-duration supersonic stream. Data from these two probes, together with Pitot pressure, will uniquely define the state and velocity of a gas in equilibrium. Both probes utilize pressure and temperature measurements in a plenum chamber, with which the mass flow rate through a sonic exit orifice is computed. A heat exchanger ahead of the plenum chamber cools the gas to simplify these measurements. The probes differ only in the design of the inlet and diffuser. The total-enthalpy probe has a subcritical diffuser, with a detached bow shock wave. A sonic throat in the inlet permits the stagnation temperature to be computed from the mass flow and the stagnation pressure behind the detached shock wave, which is equal to the measured Pitot pressure. Thus total enthalpy, which is conserved across the shock wave, is obtained.
Author

N65-13944 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
TRANSITORY RESPONSE OF THERMAL SONDES [REPONSE TRANSITOIRE DE SONDES THERMIQUES]
Jean-Pierre Chevallier *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 4 p refs in FRENCH (See N65-13922 04-14)

A numerical resumé is given of a thermal transitory monodimensional problem for conditions limited to particular functional schemes of sondes with thermoelectric couples. Using parameter reduction, the temperature reached by a point of a wire is obtained; next, a limited length is subjected to a convective flux corresponding to the temperature range of the ambient medium. The results obtained are applied to determining the time of response of the sondes to stopping

temperatures (in blowdown wind tunnels) and to flow temperatures (in arc tunnels). They permit the evaluation of the errors involved and, in certain cases, of the correction to be applied to the characteristics of the sensitive element to eliminate the errors. Trans. by M.P.G.

N65-13945 Rensselaer Polytechnic Inst., Troy, N.Y.
A STATIC-PRESSURE MEASUREMENT TECHNIQUE FOR CHEMICAL KINETIC STUDIES
Rober E. Duffy *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 18 p refs (See N65-13922 04-14)

It was shown that static-pressure data can be used to measure the degree of nonequilibrium that is present in rapidly expanding high-enthalpy gas flows. Presented is a detailed description of a technique for measuring the static-pressure distribution along the axis of a hypersonic nozzle. In order to obtain precise and accurate vibrational relaxation and chemical reaction rate data, one must consider effects due to boundary-layer growth both on the nozzle walls and on the static-pressure probe, static-pressure probe size, and flow gradients in the nozzle. The data-reduction methods that were developed to account for these effects are outlined. Author

N65-13946 ARO, Inc., Arnold Air Force Station, Tenn.
A LOCALIZED DENSITY MEASUREMENT THROUGH THE USE OF PARTICLE SCATTERING
J. B. Dicks (Tennessee U.) and J. W. Cunningham *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 8 p refs (See N65-13922 04-14)

Methods of making a localized gas density measurement through the use of particle scattering are described. These measurements are made without introducing material probes into the flow, are suitable for wind-tunnel measurements, and in some cases are suitable for brief duration testing. Two kinds of particles and scattering processes are employed in different density ranges. At high density (above 0.1 amagat), Compton scattering of photons in a gamma-ray beam from Cs^{137} is used. At low density (below 0.1 amagat), large angle scattering of electrons from an electron gun is employed. In the case of electrons, the scattering is in the coulomb field of the nucleus of the atom. The geometry is the same in both cases. A particle beam is established in the test gas, and a detector with a collimator is arranged so that only a small part of the beam is viewed by the detector. The number of particles reaching the detector is proportional to the number of atoms in the small section of the beam viewed by the detector. Author

N65-13947 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
ORGANIZATION AND AUTOMATIC OPERATION OF MEASUREMENTS IN THE TWO ARC WIND TUNNELS OF ONERA [ORGANISATION ET DEPOUILLEMENT AUTOMATIQUE DES MESURES DANS LES DEUX SOUFFLERIES A ARC DE L'ONERA]
Michel Delattre *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 5 p (See N65-13922 04-14)

The use of a magnetic cage to shield the sensitive measuring elements installed in arc tunnels from the parasitic currents generated by the large power supplies (4800 Mv-amp) required to operate the arcs is described. The general organization of the measuring equipment to obtain values for various parameters is discussed, and the precision of the results is determined. M.P.G.

N65-13948 Denver Research Inst., Colo.
FAST RESPONSE OPTICAL PYROMETER
James P. Kottenstette *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 9 p refs (See N65-13922 04-14)
(Contract AF 33(657)-10913)

An optical pyrometer developed in conjunction with high energy reactions is described. Fast response was satisfied by using detectors having 100-kc response. Broad temperature range was defined by the sensitivity and saturation levels of the detectors. The geometry of the apparatus allows the photographing of an image of the source, and the use of multicolor technique for temperature measurement fulfills the objective of operation on sources of unknown emissivity. The theory of operation, description, and calibration of the developed multicolor optical pyrometer are outlined. E.E.B.

N65-13949 Aberdeen Proving Ground, Md., Ballistic Research Labs.
SIMULTANEOUS STREAK AND FRAME INTERFEROMETRY FOR USE IN SHORT DURATION HYPERVELOCITY FACILITIES
J. H. Spurk and D. H. Shear *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 14 p refs (See N65-13922 04-14)

A unique instrumentation system for simultaneous investigation of free stream and flows around a model in an expansion tube is described. A Mach–Zehnder interferometer with the proper combination of masks, filters, a dichroic mirror, and a rotating mirror, is used. Streak interferograms of 400μsec duration and framing records of 1μsec duration are obtained. A streak interferogram in green monochromatic light gives a continuous history of the free-stream flow, while single-frame interferograms in blue monochromatic light record the flow field about the model. The streak interferogram, in addition to monitoring quality of free-stream flow, can be used in conjuction with pressure, wave-velocity measurements, and perfect gas theory to determine free-stream conditions, notably static temperature, as necessary for the study of the flow around the model. Author

N65-13950 North Carolina State Coll., Raleigh.
A STUDY OF MEANS FOR MEASURING ELECTRON DENSITY IN A 24" DIAMETER ARC-HEATED HYPERSONIC TUNNEL
Frederick O. Smetana *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 35 p refs (See N65-13922 04-14)

A study was made of the means for measuring electron density in a 24" diameter arc-heated hypersonic wind tunnel. Calculations indicated that if the gas in the test section were in equilibrium as expected, then the electron density would be too low to measure with an X-band microwave interferometer—the lowest frequency interferometer which could be used with confidence with a gas stream of this dimension. Accordingly, new methods for measuring the electron density were sought. With one technique, the gas stream is surrounded by two hemicylindrical capacitor plates and treated as a lossy dielectric. A capacitor bridge network is employed. The equations for interpreting the measured voltages are developed. The method appears satisfactory for field frequencies between 3 Mc and 30 Mc, electron densities from 10^5 to 10^7 per cc and collision frequencies up to 10^9/sec. Estimates of the capacitance of the device are also obtained. Author

N65-13971# North American Aviation, Inc., Los Angeles, Calif.
RESEARCH ON PHOTOGRAPHIC WINDOW PROBLEM IN SUPERSONIC AND HYPERSONIC AIRCRAFT Final Technical Documentary Report, May 1962–Jul. 1963
Donald Koch, James Nixon, and Raymond Wykes Wright-Patterson AFB, Ohio, Res. and Technol. Div., Mar. 1964 220 p refs
(Contract AF 33(657)-8013)
(NA-63-717; RTD-TDR-63-4098; AD-607252) OTS: $6.00

Previous analytical predictions concerning the effects of induced window curvature on optical quality were found to be questionable. Good qualitative agreement between experimental results and the modified theory was established. Investigations of several typical aircraft trajectories has yielded useful information concerning heat transfer through camera windows, temperature distributions within the windows, and pressure differentials, as functions of time. Particularly for a high-angle and a low-angle reentry trajectory for a Dynasoar-type vehicle, a great deal of thermal data was generated during the program for evaluation of Dynasoar as a possible reconnaissance vehicle. Design criteria and techniques for thrermal protection of camera windows were evolved. Several designs for camera window mounts suitable for use in a high-temperature (2500° F) environment are included. In addition, the efficacy of protecting the window from the thermal environment was investigated. Two methods, separation of aerodynamic flow (recessing the window) and controlled expansion flow (tilting the window) were found to be feasible. Controlled expansion flow can reduce the heat input to the window by 30 to 50 percent, reducing the window temperature correspondingly. Author

N65-13979# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati
STUDY OF A SYSTEM OF SCANNING OF PICTURES OF A SPARK CHAMBER WITH COUPLED CRT-LARGE COMPUTER [STUDIODI UN SISTEMA DI SCANNING DI FOTOGRAMMI DA C. A S. CON ACCOPPIAMENTO CRT-GRANDE CALCOLATORE]
B. Bertolucci and F. Pandarese 12 Oct. 1964 12 p refs In ITALIAN *Its* Nota Interna No. 262
(LNF-64/51)

A method for analyzing spark chamber data using a cathode ray tube (CRT 31) in conjunction with an IBM 7040 computer system is described. Trans. by P.F.E.

N65-13992# Ohio State U. Research Foundation, Columbus.
INVESTIGATION INTO THE PROBLEMS OF RELATIVE ORIENTATION IN STEREO-AERIAL PHOTOGRAMMETRY Final Technical Report, Nov. 1963–Jul. 1964
Sanjib K. Ghosh Aug. 1964 156 p refs
(Contract DA-44-009-AMC-430(X))
(AD-452686)

The methods of relative orientation are studied in three broad groups; empirical (optical-mechanical), numerical, and graphical (or semigraphical). The sub-groups in each are dependent or independent methods for flat or mountainous terrains. In the numerical group a new method of assigning weights to the parallax observations is suggested for improving the quality of the existing methods. A comparative study of the various methods is made. This includes a theoretical analysis of the observational errors in typical empirical, numerical, and graphical methods. The technique of forming the variance–covariance matrices for this purpose is presented. The problem of improving the quality of a relative orientation with increased observations is studied from two points of view, with increased number of points of observation, and with increased number of observations at each of the six (minimum number) model points. The possibility of using X-parallax instead of Y-parallax for relative orientation is analyzed. A study is made of the problems of model deformation and the use of this idea in relative orientation. It was empirically determined that the standard error of X-parallax is about 0.4 times the standard error of Y-parallax measurements. Author

N65-14021# Rome Air Development Center, Griffiss AFB, N.Y. Research and Technology Div.
THE RELATION OF NUMBER OF SCAN LINES PER SYMBOL HEIGHT TO RECOGNITION OF TELEVISED ALPHA-NUMERICS
Merrill F. Elias, Alvin M. Snadowsky, and Edward F. Rizy Oct. 1964 24 p refs
(RADC-TDR-64-433; AD-608789)

To determine the effect of symbol resolution on the recognition of alphanumeric symbols displayed on a television screen (video tube), 10 subjects were repeatedly exposed to 36 symbols under 9 conditions of symbol resolution. Results indicated that, depending upon its unique configuration, a symbol will require a greater or fewer number of scan lines than another to be correctly identified. For most symbols, a resolution as low as three or four scan lines is not adequate for acceptable accuracy of identification under controlled laboratory conditions. Author

N65-14024*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
A METHOD FOR CALIBRATION OF GAS-COMPOSITION-SENSITIVE PRESSURE GAGES IN CONDENSIBLE VAPORS
Leonard T. Melfi, Jr. and Paul R. Yeager Washington, NASA, Jan. 1965 22 p refs
(NASA-TN-D-2567) OTS: HC $1.00/MF $0.50

A method is described for the calibration of gas-composition-sensitive pressure gages in condensible vapor environments over the pressure range from 10^{-3} to 15 torr. A thermal-conductivity gage was used to obtain the data presented. A discussion of the theoretical considerations of thermal conductivity is included to aid in interpreting the data obtained by experiment. Calibrations were made in dry air (as a standard), water vapor, and acetamide vapor. The gage was also calibrated in the Echo II (1964 4A) canister to demonstrate the usefulness of this method in a practical application. The data obtained by the method show significant differences for the various gas compositions. Author

N65-14025*# Industrial Nucleonics Corp., Columbus, Ohio.
CRYOGENIC QUALITY METER Final Report
C. D. Arnett, H. D. Burke, and A. M. Payne 2 Nov. 1964 201 p refs
(Contract NAS8-11736)
(NASA-CR-60065) OTS: HC $6.00/MF $1.25

An analytical study was performed to determine the most practical method for measuring the quality of cryogenic propellants being vented to a vacuum ambient, i.e., the percent of the vented fuel that is in vapor rather than liquid state. Three approaches were rated as promising for the Saturn S-IV B stage from launch through orbit—the gamma ray scatter gage, vaporization, and beta transmission meters. The first device was recommended because of its unique ability to make very accurate measurements at low quality when the line is mostly filled with liquid. R.L.K.

N65-14059# Philco Corp., Lansdale, Pa.
PEM FOR GOLD-DOPED GERMANIUM INFRARED DETECTOR TYPE IR400 Quarterly Progress Report, 1 Jul.–30 Sep. 1964
A. Guimento [1964] 56 p
(Contract DA-36-039-AMC-01464(E))
(QPR-7; AD-602213)

Work on the development and demonstration of production facilities capable of producing p-type, gold-doped germanium infrared detectors is described. Thirteen preproduction samples have been fabricated, and preliminary test data were within specifications. A toolmaker's microscope, special mandrels, and an optical comparator were used to overcome the problem of mechanical measurements of completed preproduction detectors. A special test procedure was developed for environmentally testing the preproduction samples. P.V.E.

N65-14066# Harry Diamond Labs., Washington, D.C.
TRACER METHOD OF MEASURING LOW WATER-VAPOR PERMEABILITY
E. R. Nelson, R. M. Shellenbarger, and A. Besold 1 Oct. 1964 35 p refs
(HDL-TR-1254; AD-608585)

A rapid method for the measurement of rates of permeation of water vapor through polymeric films of very low permeability was studied. It was based on the reaction of C-14-labeled barium carbide with water to give barium hydroxide and radioactive acetylene. A sweep-gas apparatus, which incorporated a Geiger tube for counting the acetylene, was built, and measurements were taken under steady-state conditions. This method proved to be rapid but neither absolute nor precise. While corrections might be applied to yield absolute values, none of the modifications that were attempted seemed to improve the reproducibility. Methods based on counting radioactive acetylene were discontinued in favor of a method based on detecting simple unlabeled, hydrocarbons, e.g., acetylene, with an argon detector. Author

N65-14085# Ohio State U. Research Foundation, Columbus. Antenna Lab.
A STUDY OF AN OPTICAL SPATIAL FILTER SYSTEM
Charles T. Bunnell (M.S. Thesis) 6 Apr. 1964 54 p refs
(Contract AF 33(616)-7843)
(Rept.-1222-14; AD-604247)

The effects of the quality of the optical equipment and its alinement on the quality of the final filtered image was investigated experimentally. The results demonstrated the following: (1) Irregularities on the bulb are transmitted through the pinhole and appear as spots on the photograph. (2) The quality of the plane wave, and thus the size and shape of the error spectrum depend on the size of the pinhole. (3) A lens that is not precisely ground is not as much of a problem as the presence of minute scratches and other flaws. (4) the position of the spectrum plane is critical because of the small size of the spectra and of the filters used. (5) The problem of phase error arises when a photographic transparency is used. D.S.G.

N65-14092# General American Transportation Corp., Niles, Ill. MRD Div.
INVESTIGATION OF FATIGUE FAILURE DETECTION SYSTEMS USING INFRARED TECHNIQUES Technical Documentary Report, 11 Jun. 1962–30 Aug. 1963
G. Schmitz and M. Levine Wright-Patterson AFB, Ohio. Res. and Technol. Div., Oct. 1964 68 p refs
(Contract AF 33(657)-8828)
(RTD-TDR-63-4293; MR-1204; AD-608926)

The purpose of the program was to determine the applicability of a noncontacting infrared detection system for use with fatigue specimens in the sonic test facility. The breadboard model of a detection system was constructed. The system used a radiative heat source and an infrared radiometer to detect changes in the heat-transfer characteristics due to fatigue flaws in structural metals. Tests of the system were performed on artificial and actual flaws. The system proved able to detect the larger fatigue failures. These results demonstrate the feasibility of the system, and further investigation with the construction of a prototype system is recommended. Author

N65-14283# Lane-Wells Co., Houston, Tex.
A SEDIMENT DENSITY METER
Billy F. Wilson Washington, AEC, Apr. 1964 48 p refs
(Contract AT(40-1)-3118)
(ORO-622) OTS: $2.00

A sediment density meter has been developed for in situ measurement of ocean bottom materials in the range from about 1.0 to 2.0 per cc. The measurement is based on the scattering of gamma rays from a radiation source contained in the device, which is lowered on a cable into unconsolidated sediments. The gamma ray intensity is measured by a Geiger counter assembly and is photographically recorded by a camera in the instrument while the sensing probe is moved stepwise upward from solid bottom through a range up to 11 feet of sediments. The device is about 26 feet long and is powered by self-contained batteries. Author

N65-14297# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
APPLICATION OF HETERODYNE ANALYZERS TO PULSE ANALYSIS
John S. Quinn and Charles Edward Thomas (M.S. Thesis) Aug. 1964 109 p refs
(GE/EE/64-16; AD-607117) OTS: $4.00

Measurement of the amplitude and phase spectra of shock pulses is investigated. Sampling theory is used to show that these spectra may be uniquely defined by samples that can be determined from measurements made on a periodic extension of the shock pulse. It is shown that heterodyne analysers can be used to measure the amplitude spectrum samples. An original phase-angle measurement system is described. The described system is used to measure the spectra of shock pulses and is shown to provide adequate results. Author

N65-14307# General Telephone and Electronics Lab., Inc., Bayside, N.Y.
A SOLID-STATE SELF-SCANNING DISPLAY PANEL Final Report, Apr. 16, 1963–Apr. 15, 1964
Stephen Yando et al Griffiss AFB, N.Y., RADC, Oct. 1964 40 p
(Contract AF 30(602)-3050)
(TR64-208-13; RADC-TDR-64-335; AD-608919)

The solid-state self-scanning display device consists basically of a piezoelectric ceramic plate which controls the point-by-point excitation of an electroluminescent phosphor layer over the plate. An investigation was carried out for the optimization of materials and structures employed in the panel. This investigation included the electroluminescent phosphor layer, a nonlinear resistor layer used to obtain high contrast, and the piezoelectric ceramic distributor with its input transducer. Techniques for coupling the different planar display components are described. A drive circuit for testing the display panel is described in detail. Author

N65-14328# Stanford Research Inst., Menlo Park, Calif.
IMAGE-INTENSIFICATION DEVICE
D. V. Geppert and B. V. Dore Aug. 1964 21 p refs
(Contract DA-44-009-AMC-580(T))
(ITR-1; AD-452778)

The feasibility of an image-intensification device employing a photon-controlled capacitor cathode was studied. Formulas were developed for determining the theoretical signal-to-noise ratio of the cathode as limited by thermal background noise. Signal-to-noise ratios were calculated for Ge and Ge-Si transducers at different doping levels and operating temperatures, assuming realistic minority-carrier lifetimes consistent with the resolution requirements of the image intensifier. It is concluded that Ge-Si alloys could be used for the transducer at room temperature, and that Ge would be satisfactory with some refrigeration. Author

N65-14343# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW TYPES OF GYROSCOPES
Andrzej Bialecki 16 Aug. 1963 9 p Transl. into ENGLISH from Pomiary Automat. Kontrola (Poland), no. 1, 1961 p 19-20
(FTD-TT-63-823/1; AD-602551) OTS: $1.00

The electronic gyroscope depends on the spin of electrons around the atomic nuclei, whereas the corpuscular gyroscope depends on the spinning of particles within the nuclei themselves. The greater mass of the proton relative to the electron gives a theoretical advantage to the corpuscular gyroscope, but problems involving maintenance of uniform direction of spin have yet to be perfected. E.K.R.

N65-14361# Princeton U., N.J. Plasma Physics Lab.
A SIMPLE DUOCHROMATOR FOR THE MEASUREMENT OF SMALL DISPLACEMENTS OF A SPECTRAL LINE
Joseph G. Hirschberg Sep. 1964 16 p refs
(Contract AT(30-1)-1238)
(MATT-301)

Doubly refracting prisms are used to convert an ordinary Ebert monochromator into a duochromator adapted to measuring small wavelength shifts in a spectral line. The instrument has the advantages of simplicity, good time resolution, high luminosity, and geometrically identical channels. An example of its use is given. Author

N65-14384# Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Environmental Test Lab.
DME-A VIBRATION TESTS OF ELECTRON TEMPERATURE PROBE, SPHERICAL ION MASS SPECTROMETER AND SENSOR ELECTRONICS-U.K. EXPERIMENTS "E" & "F"
C. C. Bates and J. S. Milne 25 Nov. 1964 9 p
(ETR-757-M)

A 10 000-lb force vibration exciter was used to test an electron-temperature probe, a spherical ion mass spectrometer, and a sensor electronics package. Gaussian random and sinusoidal inputs were used in the three mutually perpendicular planes, with random inputs between 20 to 2000 cps. Acceleration density level was 0.045 g^2/cps for 4 minutes, approximately equivalent to 9.5 g rms measured input. A soldered capacitor lead failure, during a transverse vibration on the electron temperature probe, showed the need for an improved capacitor mounting. No structural or functional failure occurred in the other two components. These prototype units are scheduled for use in the DME-A satellite. M.G.J.

N65-14406# Test Squadron (4750th), Tyndall AFB, Fla.
EVALUATION OF DIRECT SCOPE RECORDERS Final Report, 16 May-5 Sep. 1963
Frank W. Hewett 22 Sep. 1964 28 p
(AD-450270)

The objective of the test was to evaluate the usefulness of the scope camera as related to fidelity of reproduction of scope presentation, as a tool for training and maintenance troubleshooting and compared to existing recording devices. The camera did meet the objectives in that it was able to record all traces that appear on the face of the scope. The traces that are recorded can be satisfactorily used for maintenance troubleshooting, training, and data collection. The recording is superior to that obtained with the AAR system. Deficiencies were revealed which should be easily corrected in a production-type model. It is recommended that a production-type model, incorporating the suggested improvements, be obtained and tested. Based on satisfactory performance of the production model, this scope camera system would be an excellent replacement for the AAR system. Author

N65-14460# Harry Diamond Labs., Washington, D.C.
RANGEMETER FOR XM23 LASER RANGEFINDER, MODEL II
Ira R. Marcus 16 Nov. 1964 44 p ref
(HDL-TR-1262; AD-452838)

A modified rangemeter, designated model II, was constructed and determined capable for use with the XM23 Laser Rangefinder. The model II design is a high-speed, miniature, digital time-interval counter that displays range readings from 200 to 19 995 meters when coupled to the rangefinder. This range capability is twice that of the model I rangemeter. Another advantage of the model II design is that it includes a target counter, thus allowing the operator to range on any one of five target echoes. Operation of the rangemeter is based on start-and-stop pulses that are received from the rangefinder. The counter then computes and displays the range to the nearest 5 ± 5 m on a solid-state electroluminescent readout. The readout assembly is optically coupled between the computing circuits and a photoconductive readout matrix. The rangemeter system operates from $-55°$ to $+75°$ C with a 5- to 7-V supply. The time base is a 29.971-Mc crystal oscillator; the computing circuits are high-frequency flip-flops. Author

N65-14464# ARO, Inc., Arnold Air Force Station, Tenn.
THE DESIGN OF A TOTAL RADIATION THERMOPILE DETECTOR
D. F. Frazine Arnold Eng. Develop. Center, Jan. 1965 28 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-271; AD-453973)

A thermopile detector that is suitable for measuring and controlling irradiance in vacuum is described. Notable characteristics of the detector include its small physical size and output-signal zero stability. Electrical heating is provided to maintain the detector case at a nearly constant temperature. Construction details along with results of detector tests made under vacuum conditions are given. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-13374# Hanford Atomic Products Operation, Richland, Wash. Physics and Instrument Lab.
URANIUM DETECTION BY X-RAY ANALYSIS
R. B. Jacob Jul. 1964 24 p refs
(Contract AT(45-1)-1350)
(HW-83474) OTS: $2.00

A prototype X-ray fluorescent tester for detecting uranium contamination in nuclear fuel elements was constructed. The tester uses an industrial type 150 kV X-ray machine as a source of radiation. The X-ray tube is mounted on a table in a manner that will allow the beam to illuminate the fuel element end. Shielding apparatus for the X-ray tube, and transport equipment for the fuel element, are also mounted on this table. A pair of single channel analyzers and recorders comprise the remaining items in the tester. The apparatus has a detection sensitivity of approximately 0.5 wt% uranium in a volume of 0.25×10^{-3} $in.^3$. The scan speed for this sensitivity is approximately 5 in./min. A number of fuel ends were tested, and the results were compared with data from autoradiograph and other tests. Author

N65-13423# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
HIGH TEMPERATURE ALKALI METAL RESISTANT INSULATION Second Quarterly Progress Report
W. H. Snavely, R. E. Mc Vay, R. E. Stapleton, R. J. Towner, and J. W. Ogden 10 Oct. 1964 105 p refs
(Contract AF 33(615)-1360)
(WAED64-56E; AD-607276)

Discussed is an investigation of the effect of 600° to 850° C potassium vapor on selected materials in an electrical test device consisting of a transformer designed to operate in potassium vapor at 600° C. Electrical resistivity measurements, both ac and dc, have been made on several ceramic insulating materials at temperatures up to 850° C. A fluoride eutectic mixture of calcium fluoride–barium fluoride melting at 1022° C was formed. Four ceramic-to-metal seals were fabricated using an active-metal braze of titanium, columbium, and nickel composition to join columbium–1% zirconium tubing to Lucalox. Columbium–1% zirconium tubing was brazed to Type 316 stainless steel tubing using Nicrobraz 130. Pressure sintered ceramic-to-metal bonds were made and tested for shear strength. Hiperco magnetic core material exposed to potassium vapor at 600° C for 500 hours was brittle after exposure and could be shattered by a sharp blow. P.V.E.

N65-13424# Rocketdyne, Canoga Park, Calif.
FEASIBILITY INVESTIGATION OF A MOVING BELT RADIATOR Second Quarterly Progress Report, 10 Jun.–9 Sep. 1964
Oct. 1964 138 p refs
(Contract AF 33(615)-1576)
(R-5670-2; AD-607292)

Chief concerns of this program are materials compatibility, thermal conductance, and antifriction bearing operation, all at high temperatures in a hard vacuum. The materials compatibility and heat transfer investigations continued in the reciprocating-contact testers; the instrumentation and mechanical features of the small-scale model were checked out and improved; analytical optimization studies of the belt radiator were continued; detail design of the new bearing test rig and selection of retainer materials, lubricants, etc., were completed; and manufacture of parts was initiated. Author

N65-13523# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRIC WELDING EQUIPMENT AND AUTOMATION OF WELDING IN CONSTRUCTION
S. G. Sarafanov, S. M. Taz'ba, Yu. Ya. Terent'yev, and Ye. S. Feder 20 Jul. 1964 392 p refs Transl. into ENGLISH of the book "Elektrosvarochnoye Oborudovaniye i Avtomatizatsiya Svarochnykh Rabot v Stroitel'stve" Moscow, Gosstroiizdat, 1962 p 1–350
(FTD-MT-63-284; AD-605231)

The main types of electric welding equipment and of systems for automation of welding in construction are discussed. Presented are diagrams and characteristics of machines, transformers, and automata for arc welding, and of machines for resistance welding, including automatic machines for welding reinforcing grids. Author

N65-13533*# Huyck Corp., Milford, Conn. Huyck Metals Dept.
PREPARATION AND EVALUATION OF FIBER METAL NICKEL BATTERY PLAQUES First Quarterly Progress Report, 1 Aug.–31 Oct. 1964
J. L. Bidler and J. I. Fisher [1964] 37 p refs
(Contract NAS3-6006)
(NASA-CR-54235; Huyck-805(F3-25)) OTS: HC $2.00/MF $0.50

Microscopic size measurements of two grades of nickel fiber have been made and the mean, median, range, and standard deviation were calculated for length and diameter. Photomicrographs of typical particles, cross-sectional areas, and as-sintered surfaces were obtained for both nickel fiber and for carbonyl nickel powder. The pore size distribution and density of both the materials are presented as functions of sintering temperature and rolling compaction. The relative insensitivity of density and pore size distribution to sintering temperature indicates that internal surface area, electrical conductivity, and strength measurements will dictate the sintering parameters to be used to obtain optimum plaque characteristics. D.S.G.

N65-13535*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
WELDING FOR ELECTRONIC ASSEMBLIES
Washington, NASA, Nov. 1964 86 p refs
(NASA-SP-5011) GPO: HC $0.40; OTS: MF $0.75

Space-related welding technology for potential industrial use is presented in the following studies: *Fundamentals, Determination of Optimum Parameters, Equipment, Interconnecting and Component Lead Materials, Weld Inspection,* and *Process Control.* An annex contains a glossary of welding terms. G.G.

N65-13555*# Collins Radio Co., Newport Beach, Calif.
RING COUPLED FILTER DEVELOPMENT Final Report, 1 Jul. 1963–31 May 1964
D. L. Bise 24 Jun. 1964 65 p
(Contract NAS8-11507)
(NASA-CR-59843) OTS: HC $3.00/MF $0.75

Investigations showing that machined disk-ring elements are not suitable for manufacturing mechanical filters with stringent bandwidth requirements are reported. Even with tolerances on machined disk-ring elements held to a minimum, bandwidth variation could still exceed that allowable to meet the narrow sideband specification for the filters. Epoxy-bonded filters employing separate disks and rings would approach the necessary bandwidth consistency but probably not withstand

the shock and vibration requirements. Solder-bonded filters using separate disks and rings, while capable of withstanding shock and vibration, would exhibit more bandwidth variation than acceptable. However, some improvement in bandwidth consistency should be possible by improving bonding techniques. A very rigid and strong solder-bonded mechanical filter was developed that exhibited considerable reduction in spurious responses over conventional edge-coupled mechanical filters. With additional development, it should be capable of mass production to a specification with less critical requirements than the sideband specification. R.L.K.

N65-13576# Hittman Associates, Inc., Baltimore, Md.
THERMOELECTRIC BONDING STUDY First Quarterly Progress Report, 29 Jun.–30 Sep. 1964
27 Oct. 1964 27 p refs
(Contract NAS5-3973)
(NASA-CR-60027; HIT-153) OTS: HC $2.00/MF $0.50

This program encompasses an investigation of the bonding of lead telluride to shoe materials to form thermoelectric couples. The objective is to study the bonding process and to determine the mechanism or mechanisms of bond deterioration and failure in lead telluride thermoelectric elements. A secondary requirement is that the materials selected for shoes and brazes be nonmagnetic, if possible. The procedure followed to date is as follows: (1) A literature survey reviewing work in bonding PbTe at other installations was performed. (2) Potential braze and shoe materials were selected for evaluation. (3) As a preliminary test the wettability of PbTe and the selected shoe materials by each potential braze was determined. (4) The effect of small additions of various braze and shoe materials on the Seebeck coefficient and electrical resistivity of PbTe was determined. Author

N65-13622# ARO, Inc., Arnold Air Force Station, Tenn. Experimental Research Group
COMPARISON OF ELECTROMAGNETIC PUMPS WITH AND WITHOUT CONDUCTING WALLS
C. W. Mc Kinney Arnold Eng. Develop. Center, Dec. 1964 24 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-174; AD-452984)

A small dc Faraday-type electromagnetic pump was designed and built to force a relatively high resistance liquid metal (mercury) through a closed loop. The unique feature of the newly constructed pump is that the electrodes are isolated from the stainless steel tubulation by means of a high resistance ceramic cement. The design, operational difficulties, and performance characteristics are presented. In addition, a theoretical evaluation of pumps with and without conducting walls is presented. The results of the analysis indicate that the efficiency of the newly developed electromagnetic pump is improved 46 percent over conventional electromagnetic pumping systems using mercury as the working fluid. Author

N65-13623# ARO, Inc., Arnold Air Force Station, Tenn. Rocket Test Facility
AN INVESTIGATION OF THE PERFORMANCE OF A HOT-GAS JET PUMP WITH OR WITHOUT INDUCED FLOW
G. R. Lynch and C. T. Carman Arnold Eng. Develop. Center, Dec. 1964 52 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-234; AD-452985)

An investigation was conducted to evaluate the performance of a hot-gas jet pump (ejector) when pumping secondary flows of gases with various molecular weights. The agreement between the actual performance of the hot-gas ejector when pumping secondary flows and the performance predictions by momentum analysis was good. The results of this investigation show that it is possible to pump pure hydrogen at room temperature or hydrogen–oxygen exhaust products at elevated temperatures without the probability of an explosion. The performance of the hot-gas ejector with no secondary flow when using four nozzle configurations in combination with two different diffuser configurations is reported and compared with cold-flow performance predictions. Hot-flow testing was conducted to verify cold-flow diffuser performance predictions. A study was also undertaken to evaluate methods of inerting hydrogen-rich exhaust products by dilution with nitrogen, steam (water vapor), or carbon dioxide. Author

N65-13856# Dow Chemical Co., Denver, Colo. Rocky Flats Div.
COATING BERYLLIUM WITH ELECTROLESS NICKEL
W. H. Roberts 29 Dec. 1964 25 p refs
(Contract AT(29-1)-1106)
(RFP-478) OTS: $0.50

Electroless nickel is chemically reduced onto a catalytic beryllium surface according to the plating reaction $Ni^{++} + 2H_2PO_2^- + 2H_2O \xrightarrow[\text{catalyst}]{\text{heat}} Ni^0 + 2H_2PO_3^- + 2H^+ + H_2$. Since the metal deposited is also a catalyst, the coating reaction proceeds autocatalytically until metal ions and reductant ions are exhausted. The deposit, a nickel-rich phosporus alloy, is attractive, relatively free of pores, uniform in thickness, and adherent to the base metal. The steps of the plating process are: (1) initial handling of beryllium parts, including cleaning, weighing, masking, and racking; (2) coating, which involves preparation of pretreatment and plating solutions, pretreating, electroless nickel deposition, and regeneration of the plating solution; and (3) final handling, which consists of cleaning and reweighing the parts. The rate of deposition can be controlled with relative ease by regulation of plating solution variables—temperature, pH, composition, and application time. R.L.K.

N65-13864# Aerojet-General Corp., Azusa, Calif. Astronics Div.
MICROWELDS FOR MICROASSEMBLIES Final Report, Jul. 1963–Apr. 1964
R. E. Weilacker and M. Penberg [1964] 72 p
(Contract DA-36-039-AMC-02246(E))
(Rept.-2861; AD-603566)

This report covers the results of an experimental welding program in which OFHC copper ribbon was welded to nickel-plated alumina substrates, approximately 0.010-in. thick. Resulting data indicated that these welds met, and in the case of weld density, exceeded the specifications. The welded module delivered contained a weldment density of 3700 welds/in.^{2}, which exceeded the required weld density of 1600 welds/in^2. Author

N65-14028# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
A SURVEY OF THE COMPARATIVE COSTS OF FABRICATING FROM ALUMINUM AND FROM TITANIUM
Roger J. Runck 15 Apr. 1964 21 p refs
(AD-609349)

Companies with considerable experience in fabricating titanium estimate relative fabrication costs of titanium over aluminum at about 1.1–1.9 to 1. Companies with relatively little experience in fabricating titanium, except in research and development, multiply the above ratio by a factor of about 3. By process, the cost ratios for fabricating titanium and aluminum are about as follows: sheet forming, 1.5–2 to 1; machining, 1.5–2 to 1; welding, 0.8–2 to 1; chemical milling, 3–4 to 1; assembling, 1.1 to 1; forging, 1.5–2.3 to 1; and heat treating, 1.5–5 to 1. The current cost estimates made by the experienced titanium fabricators represent realistic minimum cost ratios for the next two or three years. They are ratios which the less experienced fabricators should be able to approach in actual production. The experienced fabricators could probably not improve on them greatly in the next year or two.
Author

N65-14058# SKF Industries, Inc., King of Prussia, Pa. Research Lab.
INFLUENCE OF LUBRICATION ON ENDURANCE OF ROLLING CONTACTS Progress Report No. 11, 22 Mar.–22 Jun. 1964
E. F. Brady, A. Schwartz, J. Mc Cool, R. Valori, W. Schmidt et al [1964] 75 p refs
(Contract NOw-61-0716-c)
(AL64T057; AD-609072)

The following studies were made: *Radiotracer Wear Tests*—wear tests for polyphenyl ether lubricant, and a single wear test using the base stock of a Mil-L-23699 lubricant; *Autoradiographic Particle Size Measurement in the Investigation of Wear in Rolling Contacts; Autoradiographic Study of Metallic Transfer in Rolling Contact; Surface Geometry Analysis of As-Ground Balls*—surface roughness, calibration constants, and calculations; *Conductivity Testing on Four-Ball Tester*—conductivity for the Mil-L-23699 base oil and the base mineral oil (Primol 355), and a conductivity test using as-ground balls; *Film Profile Measurements*—effect of speed on the lubricant film, film profiles at different angular orientations, and contact conductivity measurement on the two-ball tester; *Endurance Effect of Hydrodynamic Films*—plastic deformation of ball tracks.
G.G.

N65-14095*# Beech Aircraft Corp., Boulder, Colo.
RESEARCH STUDY FOR POSITIVE EXPULSION OF CRYOGENIC LIQUIDS Beech Engineering Report No. 14252, Jun. 1963–Mar. 1964
D. H. Pope and V. E. Isakson Mar. 1964 140 p refs
(Contract NAS9-513)
(NASA-CR-56388) OTS: HC $4.00/MF $1.00

The research emphasis was upon materials for use in fabricating expulsion bladders for cryogenic liquids and upon the actual testing of the bladders fabricated from the best materials. A conditioning chamber was designed and fabricated to provide a controlled environment for the materials and bladders prior to testing. A total of 18 bladders were tested. Liquid nitrogen was used as the test liquid for the material samples twist-flex tests, and liquid hydrogen and liquid nitrogen were used for the bladder expulsion tests. Basic detailed physical properties data were obtained of 21 of the most promising materials. These data include tensile, yield, elongation, tear, water absorption, specific gravity, and permeability of each material. Permeability of the unflexed and flexed materials are compared, as is the permeability of the bladder before, during, and after expulsion cycling.
Author

N65-14111# United Aircraft Corp., Windsor Locks, Conn. Hamilton Standard Div.
ELECTRON BEAM TECHNIQUES FOR FABRICATION AND ASSEMBLY OF PARTS FOR ELECTRON TUBES Fourth Quarterly Report, 1 Apr.–30 Jun. 1964
J. F. Dudenhoefer [1964] 49 p refs
(Contract DA-36-039-AMC-03625(E))
(EBR-149; AD-608556)

Supersedure of the production fabrication process for two joints in the 6914A tube and 23 joints in the 6544 tube, by electron-beam welding using production-type equipment and fixturing, demonstrated both satisfactory performance of the welding facility and acceptability of electron-beam welding for the particular joints. Six 6914A tubes and seven 6544 tubes were fabricated using electron-beam welding. Although none of these prototype tubes completely satisfied every requirement of the pertaining specification, it is important to note that none of the tube deficiencies were directly attributed to the electron-beam process.
Author

N65-14124# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
METALWORKING—REVIEW OF RECENT DEVELOPMENTS
T. G. Byrer, J. H. Gehrke, and F. W. Boulger 23 Dec. 1964 4 p refs

A manufacturing process for producing closed-die forgings of TZM molybdenum alloy for aircraft and missile requirements is summarized. The feasibility of precision forging gears and turbine wheels using a radial-extrusion technique is demonstrated. A major part of the feasibility program consisted of developing forge tooling and die inserts. In the development program for a 2400° F forging die system, the upper temperature limit of forging dies cast from Inconel 713C was determined, the steps required to change the shape from billet to final forging configuration were minimized by a combination forging and extrusion process, and materials were selected. A research program on extrusion lubricants is described in which the best results in terms of overall extruded quality were obtained with a 1:1 magnesium nitrate–graphite mixture in water.
D.S.G.

N65-14131# Goodyear Aerospace Corp., Akron, Ohio.
SOLAR REFLECTOR FOAMING TECHNOLOGY DEVELOPMENT
Paul Swanson Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Dec. 1964 157 p ref
(Contract AF 33(657)-10165)
(AFAPL-TR-64-128; AD-609223)

Detailed study, test, and fabrication of 2-foot and 10-foot diameter solar collectors have demonstrated that it is not practical to use a pressure-distributed foam system to foam large-size aluminized Mylar solar reflectors in space. The report discusses design of the mixer unit and fabrication equipment, gives results of reflectance, absorptance, and emissivity testing, and describes the fabrication of 2-foot and 10-foot diameter inflatable mirrors. Details of the testing program to determine the physical properties of mechanically mixed foam are included.
Author

N65-14143# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Aero Propulsion Lab.
RESEARCH AND DEVELOPMENT OF A FRICTION-CONTROLLED FACE SEAL
Robert J. Smith Sep. 1964 30 p refs
(APL-TDR-64-108; AD-609174)

This investigation was undertaken to develop a dynamic seal for power equipment. The concept investigated was a face seal designed so its axial load automatically varies to maintain light sliding contact on the seal faces even with large changes in the power system conditions. Preliminary testing was done on a seal sized for a 1-inch diameter shaft, sealing 20 psia nitrogen from air at room temperature, and operating at rotational speeds from 3000 to 12 000 rpm. The testing demonstrated a 20 to 1 reduction in seal friction over that attainable with conventional designs. This should correspond to a minimum increase in life of 20 times. This reduction in friction was achieved in spite of the absence of seal liquid lubrication. Author

N65-14144# Socony Mobil Oil Co., Inc., Paulsboro, N.J.
STUDY AND EVALUATION OF THE OXIDATIVE AND DEPOSIT-FORMING PROPERTIES OF HIGH TEMPERATURE LUBRICANTS Technical Documentary Report, 1 Aug. 1963–31 Mar. 1964
S. J. Leonardi and E. A. Oberright Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Nov. 1964 16 p
(Contract AF 33(657)-11741)
(ASD-TDR-62-222, Pt. III; AD-609318)

A series of high-temperature oils was evaluated in a high-temperature thin-film oxidation unit. The apparatus measures oxygen consumption and deposits formed by the oils in thin films on a rotating heated disk. Data were obtained at several film thicknesses and contact times which were varied by changing the rate at which the oil is passed over the disk. At the optimum oil flow rate, correlation of disk cleanliness with engine deposition data was excellent. A brief exploratory study indicated that provision for bulk oxidation in addition to the high-temperature thin-film oxidation could further improve the thin-film oxidation unit as a screening tool. Author

N65-14155# Joint Publications Research Service, Washington, D.C.
TITANIUM EQUIPMENT
G. M. Itel'son 31 Dec. 1964 172 p refs Transl. into ENGLISH of the book "Titanovoye Oborudovaniye" Leningrad, 1964 p 1–143, 145–148
(JPRS-28075; TT-65-30030) OTS: $5.00

The book sets forth basic data concerning different forms of processing rolled products of commercial titanium. Various equipment, manufactured from rolled products of commercial titanium are considered. The economic efficiency, future outlook, and basic trends in expanding production of titanium equipment are shown. Author

N65-14232# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TRW Electromechanical Div.
TUNGSTEN FORGING DEVELOPMENT PROGRAM Tenth Interim Technical Progress Report, 19 Aug. 1963–19 Jan. 1964
R. W. Redlinger 19 Jan. 1964 36 p refs
(Contract AF 33(600)-41629)
(ER-5750; RTD-TR-7-797(X); AD-431588)

A final prototype production run was made to verify the forging process developed for thin-section tungsten configurations. Eight arc-melted and extruded, unalloyed tungsten billets were forged successfully into a specific scaled-up, thin-section design. The process reproducibility was demonstrated by dimensional, metallographic, and mechanical property test data. Author

N65-14253# Joint Publications Research Service, Washington, D.C.
DISCUSSION CONCERNING THE CYBERNETIC PRINCIPLES OF AUTOMATION TECHNOLOGY
H. Kortum 29 Dec. 1964 18 p refs Transl. into ENGLISH from Technik (E. Berlin), Nov. 1964 p 719–724
(JPRS-28018; TT-65-30006)

Cybernetics is defined as the science of controlling processes and systems of all kinds, i.e., of natural and technological, and of biological and sociological processes and systems. A work process is defined as the programed application of one or more operations or functions to attain a certain goal. Cybernetic models are presented of the following work processes: the effect of the individual on the external world, a physical work process, an energy producing process, a mental work process, a mechanical work process, an open-end automated work process, and a closed-loop work process. Each of these work processes contains a program that is represented symbolically by an algorithm. An algorithm is presented for an automated drilling operation. Also, information, as a cybernetic concept, is interpreted as a space concept; the relationship among physical space, signal space, and information space is discussed. E.K.R.

N65-14265 Stanford U., Calif.
RELIABILITY GROWTH MODELS
Jack E. Bresenham 24 Aug. 1964 49 p refs
(Contract Nonr-225(53))
(TR-74; AD-605993)

Four different characterizations of a reliability growth process are considered. The first two models involve different-attribute reliability sampling situations. The third model concerns variable sampling of a Poisson process having a changing mean time to failure parameter. The fourth model is an investigation of the first by experimental Monte-Carlo sampling to observe the effect of parameter perturbation and hypothesis relaxation. In the first model, probability of failure is partitioned into an inherent or intrinsic component together with a transient or embryonic part. A Markov chain formulation in which states are indexed by the presence or absence of modal transient failure probability is employed for model II. Model III is concerned with the problem of growth characterization when variable data is available. P.V.E.

N65-14267 Aeroprojects, Inc., West Chester, Pa.
SEALING OF PROPELLANT CONTAINERS BY ULTRASONIC WELDING
J. Koziarski Jun. 1964 22 p refs
(Contract DA-36-034-AMC-0061A)
(RR-64-41; AD-605394)

Ultrasonic ring welding was used to make elliptical weld closures for propellant containers having an elliptical cross section, with a relationship of less than 2 to 1 between the major and minor axis dimensions of the ellipse. The original container design was modified to include an 0.015-inch-wide flange at its open end. Component materials selected were 0.010-inch Type 3003-0 aluminum alloy for the container, and 0.005-inch Type 3003-H19 aluminum alloy for the flat cover. The components were ultrasonically cleaned before being welded on a 4-kW 15-kc torsional welder. Equipment modifications included a special welding tip and a welding anvil with a positioning recess for the weldment. Prior to welding, half of the samples had been filled with calcium chloride, and half with Hercules Pistol Powder. Metallurgical evaluation indicated sound bonds, and hermetic sealing was verified by helium-leak and water-submersion tests. Author

N65-14301# Weston Instruments, Inc., Newark, N.J.
A POROUS SUBSTRATE RESISTOR AIMED AT MINIATURIZATION OF METAL-FILM RESISTORS Interim Development Report, 1 Jun.–31 Aug. 1964
T. Matley and R. E. Busch [1964] 25 p
(Contract NObsr-87542)
(IDR-8; AD-607989)

A comparison of alumina with quartz porous substrates with respect to heat dissipation was inconclusive. The absence of intercommunicating porosity in the central portion of the alumina substrates prevented proper metallization. Temperature-gradient data were found to be very useful in appraising the quality of the terminals nondestructively. A resistance shift (hysteresis) is evident upon electrical loading. The magnitude of the shift is beyond what can be explained by temperature and/or voltage coefficients. Resistance hysteresis is still marked in resistors that are made from substrates with the most uniform structural properties. Author

N65-14331# Standard Pressed Steel Co., Jenkintown, Pa.
STRUCTURAL FASTENING TECHNOLOGY Progress Report, Nov. 1963–Feb. 1964
T. A. Roach, Jr., M. H. Ortner, and S. J. Klach (Vitro Labs.) 10 Mar. 1964 48 p refs Prepared jointly with Vitro Labs.
(Contract AF 33(657)-11684)
(PR-2; AD-602500) OTS: $3.00

Results and conclusions of the static oxidation portion of the study are reported. Manufacture and coating of Cb 752 hardware were completed. Initial tests of deformability of coated columbium alloys were begun, as was the coating comparison portion of the program. A survey of tantalum producers was conducted, and the state-of-the-art in tantalum coatings was reviewed and updated. Threaded fasteners of Cb 752 for mechanical property tests were completed, with the exception of the threading of the nuts. Author

N65-14353# General Electric Co., Schenectady, N.Y. Tube Dept.
PRODUCTION ENGINEERING MEASURE FOR VOLTAGE-TUNABLE MAGNETRONS Quarterly Progress Report, 18 Jan.–18 Apr. 1964
E. G. Soulier and W. M. Piwnica 18 Jun. 1964 24 p refs
(Contract DA-36-039-SC-86722)
(QPR-8; AD-607793) OTS: $1.00

A summary of the problems encountered during the preproduction run is stated. Cumulative yield percentages obtained at the various basic tube subassembly stages are given. Production of ZM-6104 packages, which was limited by the inability of the packages to meet the specification's minimum anode voltage caused by the low flux-density level of the magnets, is described in detail. Conclusions for the detailed vibration testing of the tubes are given. Results in the quality-control area are stated. Author

N65-14355# Cornell-Dubilier Electric Corp., New Bedford, Mass.
PRODUCTION ENGINEERING MEASURE FOR THE PRODUCTION OF SILICON MONOXIDE CAPACITORS MICROELEMENT Quarterly Report, May 31–Aug. 31, 1964
J. J. O'Connor [1964] 24 p
(Contract DA-36-039-AMC-01478(E))
(QR-5; AD-607421)

Deposition masks were completed and used to fabricate all the required types of SiO capacitor microelements. The masks appear to be of correct dimensions. Commercially glazed and metallized substrates were tested and found satisfactory except for a thickness variation of 0.003 inch over specifications. Microelements fabricated on these substrates occasionally yielded capacitors with very low dissipation factors (0.1 to 0.5%) directly from the deposition cycle; most elements however, had DF values near 4%. A postfabrication heat treatment is used to bring the DF below 1.5%. Minor, but important modifications were made in the equipment, and the thin film monitor and microcircuit jig are operating satisfactorily. Author

N65-14357# Prodesco, Inc., Perkasie, Pa.
DEVELOPMENT OF NOMEX MESH MATERIALS Technical Documentary Report, Jun. 1963–July 1964
H. Brockman Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1964 20 p
(Contract AF 33(657)-12257)
(ML-TDR-64-208; AD-607890) OTS: $1.00

The objective was to develop a woven mesh material, using Nomex as the raw material yarn, having a 100 lb/in. breaking strength in both directions and a geometric porosity of 35% or a permeability of 900 to 1000 cu ft/minute/square foot. Twist levels from 5 to 20 turns per inch were evaluated in both warp and filling directions to determine the effect of twist on the permeability. Various constructions and weaves ranging from plain weave to mock leno were used to determine the maximum permeability with the required breaking strength. The mock leno weave was determined to be the most satisfactory to achieve a proper balance of properties. The level of twist affected the air permeability far more dramatically than was expected with the result that a rather high twist was used in the final product. This study demonstrated the feasibility of designing and weaving a fabric from Nomex nylon that would have the properties for use in a special type of parachute applications. Author

N65-14381# Signetics Corp., Sunnyvale, Calif.
AN ECONOMICAL FLAT PACKAGE FOR INTEGRATED CIRCUITS Interim Development Report, Jun. 15–Sep. 15, 1964
[1964] 23 p
(Contract NObsr-91298)
(QR-1; AD-450549)

By a process of electroplating and etching metal film interconnections were laid down. A few circuits were assembled on this substrate and where all previous steps were satisfactory, electrical continuity was established. Author

N65-14404# Collins Radio Co., Newport Beach, Calif.
FILTER CRYSTAL DEVELOPMENT PROGRAM (70 TO 150 mc) Fourth Quarterly Progress Report, 15 Apr.–15 Jul. 1964
R. A. Auriemma and W. D. Peterson 12 Oct. 1964 12 p refs
(Contract DA-36-039-AMC-03207(E))
(Rept.-523-1000651-00152F; AD-450235)

Experimental work with the emission characteristics of the radial filament configuration was carried out. The results of this experimentation are reported and include the following: (1) data on uniformity of plating thickness over the thickness range from 500 to 2000Å; (2) a measure of the repeatability of plating thickness for a given load of aluminum; and (3) data on plating thickness versus load and a formula for computing the amount of aluminum needed to achieve a given thickness of plating. A comparison of the results obtained using different frequency sources for the Schering Bridge

method of measuring motional parameters is made. These show the need for a stable frequency source in making such measurements. Difficulties encountered in polishing crystals due to breakage of blanks are mentioned. Author

N65-14410# Solar, San Diego, Calif.
EVALUATION OF RMSP TUNGSTEN SHEET Quarterly Progress Report No. 5, 1 Jul.–30 Sep. 1964
F. St. Germain et al 15 Oct. 1964 61 p refs
(Contract NOw-63-0786-d)
(ER-1399-5; AD-607605) OTS: $3.00

Studies were conducted to determine the formability behavior of RMSP tungsten sheet using a variety of shop processes and additional forming parameters were established for deep drawing and dimpling. The joining of tungsten sheet by resistance spot weld brazing with interleaves of 0.002-in. tantalum and molybdenum foils was evaluated. The platinum–boron reactive braze system was investigated to determine its suitability for joining RMSP tungsten sheet. Mechanical joining of tungsten sheet using tungsten rivets was attempted, and impacting of the rivet material at elevated temperatures was successful in producing tungsten rivets. Evaluation of single lap-shear diffusion-bonded joints was extended to cover the strength determination of double lap-shear joints when the bond area is essentially in pure shear. P.V.E.

N65-14411# Springfield Armory, Mass.
EFFECT OF ULTRASONIC CLEANING ON CORROSION RESISTANCE OF PHOSPHATE-COATED PANELS
M. S. Spivak 2 Oct. 1964 22 p
(SA-TR16-1122; AD-450566)

Zinc and manganese phosphated steel panels were exposed to high frequency vibrations (ultrasonic cleaning) in various media to determine the effect of this cleaning procedure on the corrosion resistance of the coated panels. Phosphated panels showed diminished corrosion resistance after exposure to these vibrations in water and water-based cleaners, but were not affected after exposure to ultrasonics when trichloroethylene was used as the medium. Phosphate-coated panels ultrasonically cleaned and then treated with supplementary oil (MIL-L-644) exhibited relatively the same corrosion resistance as oiled phosphated panels not exposed to ultrasonic vibrations. Test procedure is given and results are discussed. Author

N65-14418# Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.
DEVELOPMENT OF A DYNAMIC GIMBAL SUPPORT BEARING Final Report
Holloman AFB, N. Mex., AF Avionics Lab., Aug. 1964 63 p refs
(Contract AF 29(600)-4445)
(AVNI-TDR-64-3; AD-450858)

Investigated was the feasibility of supporting stable platform gimbals upon gas squeeze film bearings that have extremely low friction. An analytical study was performed on thrust, journal, and spherical bearings. A spherical bearing demonstrator and a combination thrust and journal bearing were fabricated and tested. Load test data largely confirm the analyses. It was concluded that space limitations in a practical gimbal design adversely limit bearing capacity for this application, but for low-friction support of smaller loads the concept is valid. Author

N65-14439# IIT Research Inst., Chicago, Ill. Technology Center
GLASS FIBER STRENGTH ENHANCEMENT THROUGH BUNDLE DRAWING OPERATIONS Final Report, 7 Jun. 1962–7 Sep. 1963
R. H. Cornish and R. M. Chaney 17 Aug. 1964 85 p refs
(Contract N600(19)58450)
(IITRI-8263-5; AD-450285)

Work toward the development of a production technique for the bundle drawing of fibers with greatly enhanced tensile strength is described. This work included studies on size dependence of strength, wetting–dewetting of metal from glass fibers, metallizing techniques, bundle drawing studies, bundle separation studies, and specimen fabrication. As an outgrowth of this program, E-glass fibers in the range from 1.5 to 5 microns were drawn in bundles using a glassy matrix, were separated from the bundles, and shown to have apparent hoop strengths in excess of 1 million psi as compared to the 500 000-psi virgin strengths normally observed for conventional sized E-glass fibers. Fibers produced by this method can be made in continuous lengths as opposed to whiskers limited to discrete lengths. Author

N65-14450*# General Dynamics Corp., Groton, Conn. Electric Boat Div.
MICROCONTACTOR UTILIZING HIGH-DENSITY, METALLIC SUPEROXIDES Final Report
T. V. Bolles, V. A. Speziali, and G. W. Thomson 31 Aug. 1964 102 p refs
(Contract NASw-551)
(NASA-CR-57021; U413-64-164) OTS: HC $4.00/MF $0.75

A laboratory prototype microcontactor that used high-density, metallic superoxides in revitalizing a sealed cabin atmosphere was designed, fabricated, and tested. A microcontactor is a device for producing finely divided superoxide particles by grinding a block of high-density material, and then providing intimate contact between the finely divided superoxide particles and a dynamic airstream. Test results showed that the microcontactor concept, using potassium superoxide and probably other superoxides for air revitalization, is feasible. No overproduction of oxygen was encountered, as is commonly the case when using conisters of the superoxide. The microcontactor matched respiratory quotients (R.Q.) between 0.6 and 1.1 required by man. Steady-state conditions with respect to O_2 and CO_2 concentrations were obtained after only a few minutes of operation. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-13558*# Hughes Research Labs., Malibu, Calif.
DESIGN AND CONSTRUCTION OF AMMONIA BEAM MASER Technical Summary Report
J. L. Walsh Apr. 1962 39 p
(Contract NASw-62)
(NASA-CR-55839) OTS: HC $2.00/MF $0.50

This report describes the construction of two ammonia beam masers and associated frequency translators which demonstrate, under laboratory conditions, a long-term frequency stability of better than one part in 10^{10} The masers utilize two

critically coupled cavities in order to minimize frequency pulling effects due to cavity drift. The cavities are separated by 9/4 wavelengths and are both tuned to the maser frequency. This configuration produces a minimum phase shift (due to cavity drift, etc.) of the resonant cavity system as seen by the ammonia beam. The masers incorporate a point source and tapered focuser and operate with $N^{15}H_3$ derived from a chemical source, which affords excellent beam stability. Associated with each maser is a frequency translator consisting of a 52.7 Mc crystal, whose output is multiplied and phase locked to the maser output, thus providing signals with maser stability at frequencies in a more useful part of the rf spectrum. Author

N65-13857*# International Business Machines Corp., Poughkeepsie, N.Y. Development Labs.
USE OF OPTICAL MASERS IN DISPLAYS AND PRINTERS Fourth Quarterly Report, 24 May–23 Aug. 1964
W. Kulcke, K. Kosanke, E. Max, and H. Fleisher [1964] 42 p refs
(Contract DA-36-039-AMC-00118(E))
(Rept.-6; AD-452259)

The evaluation of specifications of the deflector was continued. This includes the influence of temperature on the splitting angle between ordinary and extraordinary rays in the birefringent elements. It also includes an analytical evaluation of the influence of fabrication tolerances and bandwidth of light on the background light. Compensation of focal depth into the deflector affects the distribution of background light. The effect is discussed for various methods of compensation. Birefringent calcite crystals were cemented successfully; results are reported. A lens system for widening the laser beam to the full aperture of the deflector and for focusing the beam to the output plane is specified. Further investigations refer to the problem of electroding the electro-optic crystals. One of the suggested electronic switches for high-speed, low-power operation—the second harmonic phase modulated switch—was investigated. The experiments were performed at different speeds and voltages with promising results. Author

N65-13904 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF MASER WITH TWO SERIES RESONATORS
E. M. Belenov and A. N. Orayevskiy *In its* Izv. VUZov: Radiophys., vol. VII, no. 3, 1964 25 Nov. 1964 p 125–143 refs (See N65-13892 04-07) OTS: $6.00

In a maser using two series resonators it is possible to maintain oscillations such that the width of the radiation line is determined, fundamentally, by the transit time between the resonators. Here, there is a considerable reduction in the influence of the traveling-wave effect on oscillation frequency. The limit of stability for this type of mode depends on the parameters of the device. Author

N65-13905 Joint Publications Research Service, Washington, D.C.
PROPAGATION OF SHORT ELECTROMAGNETIC PULSES IN AN ACTIVE MEDIUM
V. I. Talanov *In its* Izv. VUZov: Radiophys., vol. VII, no. 3, 1964 25 Nov. 1964 p 144–151 ref (See N65-13892 04-07) OTS: $6.00

Relationships are obtained describing the variation in the concentration of excited atoms and in the radiation density in a medium acted on by an incident pulse of prescribed form. Author

N65-13920 Joint Publications Research Service, Washington, D.C.
TWO-QUANTUM PULSE OSCILLATORS ON PARAMAGNETIC CENTERS
V. R. Nagibarov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 271–273 refs (See N65-13892 04-07) OTS: $6.00

A two-quantum process employing the use of virtual states (combination scattering) is investigated. The process permits the generation of radiation in the microwave range after supplying input energy in the form of monochromatic optical radiation. If such a system is placed in a resonator with a natural frequency, the conditions for self-excitation are satisfied. An oscillator of millimeter and submillimeter frequencies is obtained which operates on energy of optical quanta. P.V.E.

N65-14185# Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div.
RESEARCH INTO THE CAUSES OF LASER DAMAGE TO OPTICAL COMPONENTS First Quarterly Report, 1 Mar.–31 May 1964
G. N. Steinberg [1964] 53 p refs *Its* Rept.-7735
(Contract DA-28-043-AMC-00009)
(PE-TR-7735; AD-450188)

Instruments and techniques are described by which a known and controllable Q-switched laser illumination level was obtained. This light was then used for determining the damage threshold of specially prepared dielectric mirrors and for creating internal damage in optical glass. Presentation is made of the data obtained from the experiments using the techniques described. Author

N65-14209# General Electric Co., Syracuse, N.Y. Electronics Lab.
SEMICONDUCTOR LASER ARRAY TECHNIQUES (SEMLAT) First Quarterly Report
C. S. Kim, H. Raillard, J. M. Smith, and R. Vuilleumier Griffiss AFB, N.Y., RADC, Oct. 1964 42 p refs
(Contract AF 30(602)-3414)
(RADC-TDR-64-419; AD-609064)

Systems considerations directed at simplification of the array using a GaAs oscillator in lieu of a gas laser-GaAs preamplifier are presented. Progress on diode development is discussed. A pressure transducer used for fine tuning of the GaAs oscillator was successfully tested. Experimental evaluation of a closely spaced back-to-back laser-amplifier assembly showing strong interaction between the two devices is also included. Author

N65-14217# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WIDTH OF LINES EMITTED BY LASER MODELS
V. S. Mashkevich 26 Oct. 1964 7 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 8, no. 8, 1963 p 918–921
(FTD-TT-64-841/1; AD-608179)

Kinetic equations are used to investigate the stationary conditions of a laser. Solutions of Maxwell equations with approximate boundary conditions are discussed and applied to a consideration of the effect of line narrowing in a laser. P.V.E.

N65-14311# Philco Corp., Blue Bell, Pa. Research Lab.
COHERENT OPTICAL PARAMETRIC TECHNIQUES First Quarterly Report

C. Wang Griffiss AFB, N.Y., RADC, Oct. 1964 20 p refs
(Contract AF 30(602)-3364)
(RADC-TDR-64-386; AD-608921)

The theoretical and experimental aspects of optical parametric amplification involving three waves were studied. Major achievements include (1) successful operation of high power, nearly single-moded ruby lasers, and (2) observation of parametric interaction among Raman-shifted lines. An attempt is being made to observe parametric amplification of the 6328 Å radiation from He-Ne gas laser, using the second harmonic radiation of ruby as the pump. Author

N65-14383# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
DEVELOPMENT OF MILLIMETER AND SUBMILLIMETER MASER DEVICES Interim Technical Report, 1 Jun.–31 Oct. 1964
W. E. Hughes [1964] 25 p refs *Its* Rept.-490E
(Contract AF 33(657)-10472)
(ITR-5; AD-607983)

The major effort was devoted to the construction of a dual-channel millimeter-wave spectrometer, the testing of an Fe^{3+}, $ZnWO_4$ zero-field maser, experiments on an Fe^{3+}, TiO_2 zero-field maser, and the construction of X-band maser circuitry. Each of the above program elements is described in detail, and the conclusions drawn from the experiments are given. Author

N65-14405# General Telephone and Electronics Labs., Inc., Bayside, N.Y.
CHELATE LASERS Annual Technical Summary Report, 1 Oct. 1963–30 Sep. 1964
A. Lempicki, H. Samelson, and C. Brecher 30 Oct. 1964 48 p refs
(Contract Nonr-4134(00); ARPA Order 306-62; Proj. Defender)
(TR-64-052.7; AD-450627)

Results of investigating the properties of chelates in terms of the requirements for laser action, and of studying the characteristics of the chelate laser itself are summarized. The investigations and studies led to the following conclusions: (1) Laser action can be obtained in a highly fluid medium at room temperature. Development of a laser with a circulating medium is indicated to be only a technological problem. (2) The study of the spectroscopy of chelates has revealed detailed information on the structure, symmetry, and stability of various compounds. It appears that four-ligand materials are superior from the laser point of view. (3) The great flexibility of the chelate systems has been demonstrated by such effects as the "tuning" achieved by cation addition and the variety of solvent influences. P.V.E.

N65-14446# Navy Electronics Lab., San Diego, Calif.
A VERSATILE EIGHT-METER GAS LASER SYSTEM Research Report, Dec. 1962–Mar. 1964
V. N. Smiley and A. L. Lewis 28 Sep. 1964 21 p refs
(NEL-1242; AD-607969)

An 8-meter-long, versatile gas laser and associated equipment were designed and constructed, employing three methods of excitation (60-c/s ac, dc, and rf) and a Brewster-angle prism method of intracavity wavelength selection. The high gain resulting from the extreme length of the laser facilitated the finding of previously unreported laser lines in the infrared. A novel method of facilitating the alignment of mirrors, making use of the 3.39-micron He-Ne line, was utilized. Calculations of reflectance for light polarized parallel to the plane of incidence for small deviations from the Brewster angle are given for an air–quartz interface. Author

N65-14465# Korad Corp., Santa Monica, Calif.
SOLID STATE LASER AMPLIFIER Quarterly Report, 1 Jun.–31 Aug. 1964
A. H. Gillmer, R. C. Pastor, and H. Schultz Sep. 1964 34 p refs
(Contract DA-36-039-AMC-00070(E))
(QR-6; AD-453191)

The theory of gain measurements together with experimental results were reported. Deterioration of rubies was described, and means for inhibiting the damage were developed. In this report, further gain measurements are presented. Development of spiking free lasers, both by mode control and by feedback control, is presented. It is intended to amplify the spiking free pulse to obtain a high-energy pulse in the microsecond and millisecond time scales. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-13350# Belfour Engineering Co., Suttons Bay, Mich.
TITANIUM AND TITANIUM ALLOYS Inventory Report No. 622
Oct. 1964 11 p

A current accounting of all the mechanical properties test data of titanium alloys stored in the Air Force Materials Information Center data processing system is presented. In addition to the measured test results, information on test environment, material condition, material form, and test techniques is available to supplement and define the test data. The inventory is arranged according to temperature of testing; within these groups, the data are further spread on the basis of pretest conditioning and the presence or absence of a notch in the tested specimen. P.V.E.

N65-13365# Republic Aviation Corp., Farmingdale, N.Y.
IMPROVED METHODS FOR THE PRODUCTION OF TITANIUM ALLOY EXTRUSIONS Final Technical Engineering Report, 1 Jan. 1957–31 Oct. 1963
John J. Christiana Dec. 1963 360 p
(Contract AF 33(600)-34098)
(RTD-TR-63-7-556; AD-605288) OTS: $7.65

A process has been developed to produce long, thin aircraft structural shapes in high-strength titanium alloys by a combination of hot extrusion and warm drawing. A variety of structural shapes such as angles, channels, zees, hats, and tees were extruded in the following titanium alloys: Ti-155A, MS 821, Ti-7Al-4Mo, Ti-4Al-3Mo-1V, and Ti-6Al-4V. Author

N65-13399# Joint Publications Research Service, Washington, D.C.

OXIDE COATINGS OF METALS

P. K. Lavorko 23 Dec. 1964 85 p refs Transl. into ENGLISH from the book "Oksidnyye Pokrytiya Metallov" Moscow, State Sci.-Tech. Machine Bldg. Publishing House, 1963 p 70-105, 134-152, 184
(JPRS-27969; TT-64-51991) OTS: $3.00

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3. THE OXIDATION OF MAGNESIUM AND MAGNESIUM ALLOYS p 60-67
4. THE OXIDATION OF COPPER, ZINC, SILVER AND OTHER NONFERROUS METALS p 68-82 refs

N65-13401# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NONFERROUS METALLURGY

29 Jun. 1964 261 p refs Transl. into ENGLISH of the book "Tsvetnaya Metallurgiya" Ordzhonikidze, Izd. Severokavkazskogo Gornomet. Inst., 1963 p 1-188
(FTD-MT-64-13; AD-603549)

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23. NATURE OF SURFACE LAYER OF TITANIC ALLOYS DURING VACUUM ANNEALING N. M. Pul'tsin and V. B. Pokrovskaya p 215-222 (See N65-13413 04-17)
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N65-13402# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CURRENT YIELD DURING ELECTROLYSIS OF MELTED SALTS AND SURFACE PROPERTIES OF ELECTROLYTE

A. L. Belyayev and Ye. A. Zhemchuzhin *In its* Nonferrous Met. 29 Jun. 1964 p 62-68 refs (See N65-13401 04-17)

The effect of surface properties of an electrolyte on the current yield during electrolysis of aluminum and magnesium was studied. The conclusions, which were considered valid for other cases of electrolysis of melted salts involving the forming of liquid metals on the cathode, are as follows: (1) During electrolytic production of liquid metals in melted salts, the appearance of finely dispersed metal in the electrolyte is due to the formation and disproportioning reactions of cations of lowest valence, $2Me^{+} \rightarrow Me + Me^{2+}$. (2) The effect of electrolyte surface properties on current yield is determined by the increase in interphase tension on the boundary electrolyte and on the nonpolarized surface of the liquid metal, promoting the appearance of small particles of metal and an increase in current yield. D.S.G.

N65-13403# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EQUILIBRIUM OF SYSTEM K_2O-Al_2O_3-H_2O
V. V. Zhukovetskiy *In its* Nonferrous Met. 29 Jun. 1964 p 69–73 refs (See N65-13401 04-17)

The equilibrium of the system K_2O-Al_2O_3-H_2O at 95° C was investigated in the range of alkali concentrations used in industrial production of alumina from minerals. It was established that the solubility of aluminum oxide in solutions of caustic potassium increases with increasing concentration of alkali, but to a lesser degree than in the system Na_2O-Al_2O_3-H_2O. D.S.G.

N65-13404# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOINT SOLUBILITY OF CALCIUM AND MAGNESIUM IN MELTED BISMUTH LEAD AT 400°
P. I. Fedorov and V. I. Shachnev *In its* Nonferrous Met. 29 Jun. 1964 p 104–112 refs (See N65-13401 04-17)

Investigation was made by the method of isothermal analysis which consisted of producing equilibrium alloys at 400° C, holding for liquation of the solid phase, subsequent hardening, and chemical analysis of lower and upper layers. The composition of crystals of the solid phase was determined by the Streinemakers residues method. Assessment of the solubility of solid phases was supplemented by the study of their microstructure and the measurement of microhardness. The tetrahedral lead angle formation for the system Pb-Bi-Ca-Mg is discussed in detail. D.S.G.

N65-13405# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VAPOR PRESSURE OF ALUMINATE SOLUTIONS
Ye. I. Zhukovskiy, V. V. Zhukovetskiy, and S. M. Balanin *In its* Nonferrous Met. 29 Jun. 1964 p 113–121 refs (See N65-13401 04-17)

The vapor pressure of aluminate solutions of the same concentrations used in the leaching of nephelinic sinters is lowered with increasing concentration of alkali, and is independent of the concentration of aluminum oxide. Boiling point determinations of alkaline and aluminate solutions with caustic moduli 1.58 and 1.78, within wide limits of concentration demonstrated that the aluminum oxide concentration had little effect on the boiling point. Water activity in aluminate solutions remained constant over a wide range of temperatures and did not depend on the concentration of aluminum oxide. The assumption of existence of aluminate ions of increased valence in solution was not confirmed. D.S.G.

N65-13411# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF NONMETALLIC INCLUSIONS ON CERTAIN PROPERTIES OF ALUMINUM AND ITS ALLOYS
V. P. Ivanov and A. G. Spasskiy *In its* Nonferrous Met. 29 Jun. 1964 p 197–206 refs (See N65-13401 04-17)

As a result of the study of the influence of oxide inclusion on gas saturation and gas generation in aluminum and its alloys, the following measures were recommended to ensure high quality castings: (1) preliminary purification of initial charge materials from oxide film; and (2) refining of the melts with chlorine-containing substances or by conversion of the oxides to α-Al_2O_3. Although it is not possible to achieve full removal of hydrogen from aluminum under atmospheric conditions, most of it is removed during the process of cooling, and the quantity remaining does not lead to porosity of the castings. D.S.G.

N65-13412 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHARACTER OF DISTRIBUTION OF HARDNESS THROUGH MODIFIED LAYER OF TITANIC ALLOYS
N. M. Pultsin and V. S. Rudenko *In its* Nonferrous Met. 29 Jun. 1964 p 207–214 refs (See N65-13401 04-17)

As a consequence of exposure to air at high temperatures, the surface layer of titanium alloys becomes saturated with oxygen, and a significant increase in its hardness is observed. The variation in structure and hardness as a function of depth of the modified layer was investigated. It was established that the distribution of hardness through the modified layer conforms to the logarithmic law. Calculations of the distribution of impurities as they diffuse through the surface layer demonstrate a similar logarithmic form. It is concluded that the distribution of hardness may be expressed by an equation analogous to the diffusion equation. D.S.G.

N65-13413 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NATURE OF SURFACE LAYER OF TITANIC ALLOYS DURING VACUUM ANNEALING
N. M. Pultsin and V. B. Pokrovskaya *In its* Nonferrous Met. 29 Jun. 1964 p 215–222 (See N65-13401 04-17)

Vacuum-annealed samples of binary and multicomponent alloys of titanium containing chromium, aluminum, iron, and silicon were studied to determine the effects of the annealing on the structure, hardness, and chemical composition of the surface layers. It was found that the higher concentrations of the alloying elements in the surface layers were due to the volatilization of titanium. Because of the change in chemical composition and structure, the increase in hardness, and the appearance of stress concentrators on the corroded grain boundaries, it is concluded that the effect of prolonged annealing may reduce the operational reliability of parts made from these materials. D.S.G.

N65-13414 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MECHANISM OF HARDENING OF PRODUCTS MADE OF SINTERED ALUMINUM POWDER
V.A. Shelamov *In its* Nonferrous Met. 29 Jun. 1964 p 223–230 refs (See N65-13401 04-17)

The cause of hardening and softening of sintered aluminum powder (SAP) during deformation processes is explained on the basis of its structure as well as concepts of hardening in metals. The crystal structure of SAP represents a distorted pure-aluminum lattice with an interstitial oxide within it, distortions are in the form of micropores and microcracks. The nonmonotonic change in mechanical properties of SAP sheets, with an increase in total deformation, is connected with the disturbance of the previously formed structural oxide network and an increase of the quantity of oxide particles. With this process, simultaneous mechanical and diffusion-hardening occurs. During cold deformation of SAP, there exists a critical degree of deformation beyond which nonreversible destruction of the oxide network occurs and leads to softening of the material. D.S.G.

N65-13415 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CORROSION RESISTANCE OF IRON-ALUMINUM ALLOYS IN FLUORINE AT TEMPERATURES OF 500°—700°

M. A. Stepanov, A. V. Kurdyumov and V. N. Goloborodov *In Its* Nonferrous Met. 29 Jun. 1964 p 231-238 refs (See N65-13401 04-17)

As the aluminum content in iron–aluminum alloys is increased from 5.5% to 31%, the hardness increases from 166 to 444 units on the Brinnel scale. Tests established that the corrosion resistance of all the alloys is very low in fluorine at elevated temperatures. At 500° C the corrosion rate is determined in tens of grams/m^2-hour, while at higher temperatures (600° to 700° C) destruction proceeds even more intensively. D.S.G.

N65-13440# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NEWS OF SCHOOLS OF HIGHER EDUCATION. AERONAUTICAL ENGINEERING (SCIENTIFIC LIFE)

28 May 1964 45 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 4, 1962 p 155–173
(FTD-MT-63-297; AD-606748)

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1. ALL-UNION INTERCOLLEGIATE SCIENTIFIC AND TECHNICAL CONFERENCE ON PROBLEMS OF MACHINABILITY OF HEAT-PROOF AND TITANIUM ALLOYS N. I. Reznikov and K. F. Mitryayev p 1–9 refs

2. SCIENTIFIC AND TECHNICAL CONFERENCES IN THE S. ORDZHONIKIDZE MOSCOW ORDER OF LENIN AVIATION INSTITUTE V. I. Lopatin p 10–14 refs

3. INTERCOLLEGIATE CONFERENCE REPORT ON PROBLEMS OF AUTOMATION OF DURABILITY INVESTIGATIONS V. K. Zolotukhin p 14–15 refs

N65-13496# Texas U., Austin. Structural Mechanics Research Lab.

THE EFFECT OF A HYDROSTATIC STATE OF STRESS ON THE PROPAGATION OF PLASTIC WAVES IN METALS

James D. Chalupnik (Ph.D. Thesis) 8 Sep. 1964 46 p refs
(Contract DA-ARO(D)-31-124-G453)
(AROD-3267-1; AD-451452)

Static and dynamic stress and strain measurements were made on specimens of high-purity copper (99.995 percent) and selected Armco iron subjected during the measurements to hydrostatic confining pressures ranging from atmospheric to 100000 psi. The strain rates were varied over a range of 0.001 to 10000 sec^{-1}. It was found that both materials exhibited a strain-rate dependence of the form $\dot{\epsilon}'' = (1/\tau)[(\sigma - \sigma_0)/\sigma_0]^{m'}$ and that m' and τ were dependent on pressure. It was found that the yield strengths of these materials depend on both hydrostatic confining pressure and strain rate. Author

N65-13550# Arde-Portland, Inc., Paramus, N.J.

DEVELOPMENT OF HIGH STRENGTH ALLOYS BY CRYOGENIC STRETCH FORMING, PART I Final Report

R. H. Alper 17 Sep. 1964 100 p refs
(Contract NOw-63-0387-c)
(AD-606877) OTS: $4.00

A series of experimental heats were prepared and evaluated for their response to stretching at −320° F as well as to subsequent aging at 800° F. Results indicate that the highest strength levels could be achieved when type 301 stainless steel was alloyed with hardener elements. For example, uniaxial strength levels of 350000 psi were obtained with alloys containing niobium and aluminum. Correlation was conducted by means of a computer programed multiple-regression analysis. The strain response of straight type 301 was improved, and the aging response of some of the type 301 heats was greatly improved. Results on similar work on other alloy systems is reported. D.E.W.

N65-13557*# Ilikon Corp., Natick, Mass.

BASIC STUDIES ON DISPERSION HARDENING Quarterly Report, 12 Jul.–11 Oct. 1964

Robert Grierson 23 Oct. 1964 11 p ref
(Contract NASw-726)
(NASA-CR-59692) OTS: HC $1.00/MF $0.50

Studies were continued on transmission electron microscopy strain measurements of TD (Ni + 2% ThO_2) nickel foils, X-ray diffraction strain measurements of well-annealed flat Ni + 1% Cr plates and cold-worked TD nickel plates, and the preparation of TD nickel and pure Ni specimens for diffusion and agglomeration studies. G.G.

N65-13570# Toronto U. (Canada). Inst. for Aerospace Studies

AN INVESTIGATION OF THE STATISTICAL DISTRIBUTION OF CONSTANT AMPLITUDE FATIGUE ENDURANCES FOR A MARAGING STEEL

F. Cicci Jul. 1964 57 p refs
(UTIAS-TN-73; AD-448046)

This note presents the results of a series of constant-amplitude, rotating, bending, fatigue tests on an 18% nickel–cobalt–molybdenum maraging steel using four fatigue machines. The fatigue endurances were established using 48 specimens at each of five stress levels close to the "knee" of the constant amplitude S_a-log N curve. The statistical distribution of endurances at each stress level was investigated and was assumed to arise from a single log-normal population, two log-normal populations, and two extreme-value populations. A comparison was also made between the log-normal, extreme value, and Maxwell–Boltzmann distributions representing the endurances for one stress level. Author

N65-13614# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.

MECHANICAL BEHAVIOR OF HEAT-TREATED AISI 4340 STEEL UNDER BIAXIAL STRESS AND RAPID HEATING

C. W. Austin, Jr. Sep. 1964 55 p refs
(RR-TR-64-16; AD-453415)

This report presents the results of biaxial stress tests under rapid heating conditions on AISI-4340-steel tubular test specimens heat-treated to a tensile yield strength of 228000 psi. The test specimens were subjected to uniaxial tension and to tension-tension (axial:tangential) biaxial stress levels of 150000, 170000, and 190000 psi and heating rates of 50°, 100° and 500° F/sec. In general, increasing the heating rate delays specific amounts of plastic deformation to higher temperatures for all stress levels and biaxial stress ratios. For engineering purposes, the biaxial deformation behavior of this material could be predicted from uniaxial tests at plastic strains up to 2% for a heating rate of 50° F/sec for stress levels of 170000 and 190000 psi. The biaxial plastic flow of this material could also be predicted from uniaxial data for the 1:1 and 1:2 biaxial stress ratios for all three stress levels for strains of less than 0.5%. Author

N65-13782# University Coll., Cardiff (Gt. Brit.)
IRON-CHROMIUM-NITROGEN ALLOYS Annual Technical Report
R. Rawlings and G. LL. Richards 31 May 1964 28 p refs
(Contract DA-91-591-EUC-2863)
(ATR-4; AD-445860)

The solubility of CrN in ferrite containing 10% Cr was determined by measuring the internal friction of specimens vibrating in torsion at about 0.8 cps. Nitrogen was diffused into the alloy by holding the specimens in cracked ammonia at the temperature for which the equilibrium was required. Measurement of the height of the Snoek peaks indicated that the solubility product (Cr) (N) increases with chromium content at 700° and 800° C. The formation of nitride at 700° and 800° C in an Fe–13% Cr alloy was investigated using various metallographic techniques. The study at 800° C was complicated by the reversion of ferrite into austenite giving a partial martensitic structure at room temperature. The nitride was identified by X-rays as CrN. In specimens nitrided at 700° C there were no complications and coarse CrN precipitates were observed both at and within the ferrite grains. The precipitate occurred mainly as angular particles but occasionally as rods. The problem of the nucleation of the nitride is discussed, and it is believed that dislocations are the most probable nucleating sites within the grains. R.L.K.

N65-13786# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRODES AND FLUXES FOR ARC WELDING
N. B. Fishbeyn 23 May 1963 69 p refs Transl. into ENGLISH of the book "Elektrody i Flyusy Dlya Dugovoy Svarki" Moscow, Gos. Nauchno-Tekhn. Izd. Mashinostr. Lit., 1961 p 1–62
(FTD-TT-62-1522/1+2; AD-606284)

This popularized text for welders covers electrode production technology and properties of electrodes and fluxes. It recounts the history of the development of electrodes and fluxes, describes the influence of electrodes and fluxes on the quality of welded joints, and gives examples of the mechanization of electrode production. R.L.K.

N65-13791# IIT Research Inst., Chicago, Ill.
RESEARCH ON THE BASIC NATURE OF STRESS CORROSION FOR VARIOUS STRUCTURAL ALLOYS AT ROOM AND ELEVATED TEMPERATURE
F. A. Crossley Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1964 79 p refs
(Contract AF 33(657)-10971)
(ASD-TR-61-713, Pt. III; AD-605703)

Wrought, high-strength aluminum alloys characteristically have markedly inferior resistance to stress corrosion in the short-transverse direction relative to resistance in the longitudinal and long-transverse directions. The anisotropy of resistance is due to marked anisotropy of microstructure. Investigation of experimental and commercial 1-in. plate showed that the elongated, platelike grain structure usually found in commercial materials was associated with short life, whereas equiaxed or irregular grain structure was associated with significantly longer life. Excess alloy content resulting in second-phase particles in the microstructure contributes to the development of the undesirable elongated grain structure. Exposure at 650° F under stress for times of 1400 or 2000 hr gave no indication that the steels PH 13-8 Mo and PH 14-8 Mo are susceptible to hot salt stress corrosion. Experiments to determine the kinetics of hot salt stress-corrosion cracking of Ti-8Al-1Mo-1V alloy are described. Author

N65-13799# Joint Publications Research Service, Washington, D.C.
STUDIES IN METAL SCIENCE AND HEAT TREATMENT
G. I. Pogodin-Alekseyev 24 Nov. 1964 104 p refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 3, 1964
(JPRS-27511; TT-64-51760) OTS: $4.00

The following metallurgy studies are included in this report: *Boration of Cobalt Alloys and Alloys Based on Cobalt; Mechanism for the Formation and Properties of a Borated Layer in Iron and Nickel Alloy; A Study of the Properties of EP51 and EP52 Steel at High Temperatures; Use of Microstructure Analysis for Studying the Deformation Process of Palladium During Heating and Expansion in a Vacuum; and Study of Recrystallization of Baked Aluminum Powder (SAP).* E.C.

N65-13832# Los Alamos Scientific Lab., N. Mex.
FUSED SALT ELECTROREFINING OF MOLTEN PLUTONIUM AND ITS ALLOYS
L. J. Mullins and J. A. Leary 6 Nov. 1964 33 p refs Presented at the Symp. on High Temperature Processing in the Nuclear Industry, Am. Chem. Soc., Chicago, 2 Sep. 1964
(Contract W-7405-ENG-36)
(LA-3118)

Results of an extensive development program that culminated in construction of a 40-kg-per-month-capacity electrorefining plant are reviewed. High-purity plutonium is produced in good yield on the 0.2- to 3.5-kg scale. Impure plutonium metal, Pu–10 at.% Fe alloy, and Pu–3 at.% Ga alloy were refined routinely to plutonium that contained less than 100 ppm by weight of metallic impurities. The theory of plutonium alloy electrorefining is developed. In particular, the behavior of elements that are commonly present in impure plutonium metal, such as uranium, thorium, iron, and gallium, is reviewed. The special case of americium-241, which results from the decay of plutonium-241 is considered in detail. The effects of process variables such as refining temperature, current density, molten salt electrolyte composition, and stirring on the process are discussed. In addition, various ceramics and refractory metals are evaluated as container materials for molten salts and molten plutonium. Author

N65-13833# Joint Publications Research Service, Washington, D.C.
THE FURNACE BRAZING OF METALS USING A CONTROLLED ATMOSPHERE
R. Ye. Yesenberlin 4 Jan. 1965 134 p refs Transl. into ENGLISH of the book "Payka Metallov v Pechakh s Gasovoy Sredoy" Leningrad, Mashgiz, 1962 p 1–130
(JPRS-28102; TT-65-30039) OTS: $4.00

An account is given of the physical and chemical processes taking place during the brazing of metals and alloys in furnaces with controlled atmospheres. Also described are the brazing compounds and gases most widely used in nonoxidizing brazing processes, and brazing equipment and technology. R.L.K.

N65-13887# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.
QUANTITATIVE PHASE ANALYSIS IN TEXTURED MATERIALS
Stanley L. Lopata and Eric B. Kula Aug. 1964 18 p refs
(AMRA-TR-64-21; AD-606884) OTS: $0.50

The problem of preferred orientation has been considered in quantitative phase analysis by X-ray diffraction techniques.

The average intensity of a diffraction peak can be obtained by integration over the whole pole figure, or by random rotation of the specimen in the X-ray beam, or by a combination of both. For rod or wire, where the pole figure shows rotational symmetry, the intensity is measured along a radius of the pole figure. Where no symmetry is present, rotational symmetry is imparted by rapid rotation of the sheet around its surface normal during measurement. These methods are applied to the determination of austenite in an Fe–31% nickel rod and Fe–28% nickel sheet. Author

N65-13889# Joint Publications Research Service, Washington, D.C.
RARE EARTH CERMETS
G. V. Samsonov 7 Jan. 1965 27 p refs Transl. into ENGLISH of the book "Tugoplavkiye Soyedineniya Redkozemel'nykh Metallov s Nemetallami" Moscow, 1964 p 53, 55–57, 54–62, 88–92
(JPRS-28165; TT-65-30076) OTS: $1.00

Methods for preparation and use of the following rare-earth cermets are discussed: *Rare Earth Borides; Rare Earth Carbides; Rare Earth Silicides; Rare Earth Sulfides;* and the preparation of *Rare Earth Nitrides.* G.G.

N65-13952# Saarland U., Saarbrücken (W. Germany). Inst. für Werkstofftechnologie und Allgemeine Hüttenkunde
STUDIES OF THE STRUCTURE AND THE FORMING BEHAVIOR OF ALLOYS IN THE SYSTEM TUNGSTEN CARBIDE-TITANIUM CARBIDE-TANTALUM CARBIDE-COBALT [UNTERSUCHUNGEN UBER DIE STRUKTUR UND DAS VERFORMUNGSVERHALTEN VON LEGIERUNGEN IM SYSTEM WOLFRAMKARBID-TITANKARBID-TANTALKARBID-KOBALT]
Manoranjan Kumar Mal (Ph.D. Thesis) [1964] 166 p refs In GERMAN

The mechanical properties of WC-Co, WC-TiC-Co, and WC-TiC-TaC-Co alloys were studied at room temperature and at high temperatures. The boundaries and phase fields at temperatures from 300° to 1050° C were determined from differential thermal, metallographic, and some microscopic observations. The results are presented in a number of phase curves and data tables. G.G.

N65-13989# IIT Research Inst., Chicago, Ill. Technology Center
INTERFACE FRICTION IN HOT METAL DEFORMATION Bimonthly Report, 24 Jul.–23 Sep. 1964
J. A. Schey 22 Oct. 1964 7 p
(Contract NOw-64-0458-f)
(IITRI-B6027-2; AD-609115)

An investigation of frictional phenomena encountered at the interface of tool and workpiece during the hot deformation processing of metals is discussed. A procedure established to provide reproducible surface conditions involves the degreasing of the specimen and anvils followed by dressing on 600-grit polishing paper prior to each series of impressions. Experiments were carried out at room temperature with the best lubricant known in current technology. The forces developed in dry compression at 20° C were substantially higher than those developed with full lubrication. Compression with various anvils gave not only different forces, but also different trends. With an annealed 1095 anvil, the force required for a given reduction tends to increase for successive impressions; when using the 4340, H-11, and 304 anvils, the force decreases. A significant decrease in the force required for deformation was noted for the 304 anvils as compared with that for 4340, H-11, or 1095 anvils. P.V.E.

N65-14029# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
NOTES FROM AN OPEN SESSION OF THE SUBCOMMITTEE ON MICROSTRUCTURE AND FRACTOGRAPHY
W. R. Warke 5 May 1964 7 p
(AD-609338)

Among the studies discussed are: (1) the problem of stress corrosion cracking of austenitic stainless steel in the presence of chloride ions; (2) properties of the unidirectionally solidified eutectic alloys Cu-Cr, Al-Ni, and Al-Cu; (3) fractography as a tool for the analysis of fatigue failures; (4) fatigue striation formation; (5) fracture of epoxy resins; and (6) comparison of the fracture toughness of commercial and high-purity 7075-T6 aluminum alloy. R.L.K.

N65-14030# Battelle Memorial Inst., Columbus, Ohio.
LOW-TEMPERATURE CREEP CHARACTERISTICS OF Ti-5Al-2.5Sn AND Ti-6Al-4V ALLOYS
John A. Van Echo 8 Jun. 1964 6 p refs
(AD-609343)

A summary of the creep data available on these alloys at room temperature is presented, along with creep rates for two grades of unalloyed titanium, A-55 and A-70. The evidence shows that creep does occur in these alloys at room temperature, contrary to general belief. The fairly wide spread in tensile properties, shown in the literature, is accounted for by differences in processing histories and in the chemistry of individual heats. R.L.K.

N65-14031# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
AN INTRODUCTION TO MAGNESIUM ALLOYS
John B. Hallowell and H. R. Ogden 26 Aug. 1964 22 p refs
(Contract AF 33(615)-1121)
(DMIC-206; AD-608142)

This report describes the characteristics and properties of existing commercial magnesium alloys and compares these relative to each other. The eight major alloying elements which are used to control the properties of magnesium are listed, along with selected data illustrating the binary phase relationships which exist between the hexagonal, close-packed structure of magnesium and each of these metals. The nomenclature system for commercial magnesium alloys is explained, and compositions and available forms of the alloys are given. Property comparisons of both cast and wrought alloys are presented. The joining, forming, and machining of magnesium are discussed, as well as a number of finishing systems which have been developed for magnesium alloys. Author

N65-14069# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
IMPROVED METALLOGRAPHY FOR TiC and TiC-C ALLOYS
E. G. Kendall, J. H. Richardson, and C. Hays (NASA, Marshall Space Flight Center) 30 Oct. 1964 18 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-251; TDR-269(4240-10)-16; AD-609293)

A new metallographic method for improved microscopy of TiC and alloys of TiC-C is described. The complete processing recommendations for sectioning, grinding, intermediate and final polishing, as well as anodization to produce definitive microstructures in color are included. Author

N65-14103# United Aircraft Corp., East Hartford, Conn. Research Labs.

RESEARCH INVESTIGATION OF PHASE-REINFORCED HIGH-TEMPERATURE ALLOYS PRODUCED DIRECTLY FROM A MELT

J. A. Ford, F. D. Lemkey, and B. J. Bayles 15 Oct. 1964 27 p refs

(Contract DA-19-020-AMC-00434(X))

(AMRA-CR-64-05/1; AD-453442)

The results of preliminary studies on potential whisker-reinforcing high-temperature eutectic alloys are presented. The eutectic compositions were reestablished in the Ni-Ni_3B and Ni-NiBe systems, and the published eutectic composition confirmed in the Ta-Ta_2C system. Unidirectional solidification experiments indicated that the Ni-Ni_3B, Ni-NiBe, and Ta-Ta_2C systems are "normal" eutectics. The systems Ni-Ni_3B and Ni-NiBe were unidirectionally solidified at slow rates to form lamellar microstructures. The Ni-Ni_3B system is comprised of the boride as the matrix with discontinuous Ni platelets as the dispersed phase, and the Ni-NiBe system consists of a Ni matrix with dispersed NiBe platelets. Although unidirectional solidification experiments have been unsuccessful to date in the systems Ta-Ta_2C and Ti-TiB, needlelike phases of Ta_2C and TiB have been isolated from eutectic microstructure. The results of preliminary mechanical testing and microhardness determinations on as-cast and unidirectionally solidified eutectic and pro-eutectic alloys in each of the systems are presented. Author

N65-14114# Union Carbide Corp., Parma, Ohio. Carbon Products Div.

RESEARCH STUDY TO DETERMINE THE PHASE EQUILIBRIUM RELATIONS OF SELECTED METAL CARBIDES AT HIGH TEMPERATURES

R. V. Sara and C. E. Lowell Wright-Patterson AFB, Ohio, AF Mater. Lab., Oct. 1964 65 p refs

(Contract AF 33(657)-8025)

(WADD-TDR-60-143, Pt. V; AD-608301)

Investigations were made of phase equilibria in the binary systems, tantalum-carbon, hafnium-carbon, and boron-carbon. A completed phase diagram, which encompasses experimental results and considerations heretofore unreported in the literature, is presented for the hafnium-carbon system. A phase diagram for the tantalum-carbon system is included, which, in general, resembles the version released by Ellinger in 1943. Preliminary studies on the hafnium carbide-tantalum carbide quasi-binary were limited to temperatures of 3700° C at which no liquid formation was evident. Results for the boron-carbon system, depicting maximum boron solubility in the graphite lattice at and near the eutectic temperature of approximately 2390° C, are also included. Author

N65-14118*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

PROBLEMS OF FATIGUE OF METALS IN A VACUUM ENVIRONMENT

C. Michael Hudson Washington, NASA, Jan. 1965 26 p refs OTS: HC$1.00/MF$0.50

(NASA-TN-D-2563)

The current state of knowledge of the effects of a vacuum environment upon fatigue is summarized. The effects of temperature, pressure variations, prolonged exposure, and environment composition on fatigue life are discussed in detail. In addition, studies of the surfaces of specimens fatigued in vacuum are described. Results indicate that fatigue life is better in vacuum than in air for most of the materials investigated. Most investigators attribute this increase in life to decreased oxidation of the material in the vacuum environment. Author

N65-14123# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center

BERYLLIUM REVIEW OF RECENT DEVELOPMENTS

Hugh D. Hanes 6 Nov. 1964 3 p refs

A survey is given of studies on the deformation characteristics of beryllium single crystals and the effects of iron and silicon additions on these characteristics, on the tensile properties of beryllium extrusions of various grain sizes at different temperatures, on the corrosion of beryllium by high-temperature air, on the corrosion resistance of beryllium in high-temperature water, and on the reactions of beryllium with nitrogen, air, oxygen, and carbon monoxide at high temperatures. The development of a series of beryllium–aluminum alloys for compression applications in spacecraft is reported, and the dimensional stabilization of extrusions by warm drawing is described. Extrusion and other methods of forming angle beams and tubing are discussed. Techniques for producing spherical beryllium powder by atomizing directly from the melt are mentioned. The sustitution of beryllium for fused silica in spacecraft optics is recommended. D.E.W.

N65-14146# Aeronutronic, Newport Beach, Calif.

INVESTIGATION OF MECHANISMS FOR OXIDATION PROTECTION AND FAILURE OF INTERMETALLIC COATING FOR REFRACTORY METALS Technical Documentary Report, 1 Jul. 1963–1 Jul. 1964

R. W. Bartlett and P. R. Gage Wright-Patterson AFB, Ohio, AF Mater. Lab., Jul. 1964 136 p refs

(Contract AF 33(657)-9170)

(ASD-TDR-63-753; Pt. II; U-2660; AD-609167)

An investigation of the oxidation behavior and related characteristics of bulk silicides and silicide coatings of molybdenum and tungsten was conducted. The study included (1) growth kinetics of disilicide coatings, (2) marker experiments to identify diffusing species during disilicide-coating formation, (3) thermochemical analysis of halide enhanced silicon vapor transport during coating processing, (4) growth rates of intermediate silicides in the $MoSi_2$/Mo and WSi_2/W systems using an electron microprobe technique, (5) microstructure of protective oxide films grown on $MoSi_2$ and the nonprotective oxidation products formed at low temperatures, (6) analysis of the oxidation process and the resultant chemistry of the oxidation products based on thermochemical and diffusion rate data, (7) experimental and analytical treatment of oxidation of molybdenum silicides at high temperatures, to 1600° C, and reduced oxygen pressures, and (8) correlation of experimental coating failure times, in normal oxygen atmospheres, with the required time to transform primary disilicide coatings to lower nonprotective silicide phases. Author

N65-14147# Aeon Labs., Egham (Gt. Brit.)

METALLOGRAPHY OF S.A.P. ALLOYS AND ITS RELATION TO CREEP RESISTANCE Technical Documentary Report, 15 Oct. 1962–14 Oct. 1963

I. S. Brammar and D. W. Dawe Wright-Patterson AFB, Ohio, AF Mater. Lab., Oct. 1964 69 p refs

(Contract AF 61(052)-463)

(ML-TDR-64-211); AD-608868)

The structures of several different S.A.P. alloys (sintered aluminum–alumina powder metallurgy alloys) were investigated by means of transmission electron metallography. The dispersed aluminum oxide was shown to be γ-Al_2O_3. The aluminum matrix of all the samples examined will not undergo grain growth until the metal has been deformed greater than 98% reduction in thickness. Specimens

were examined after creep tests and stress rupture tests, but no significant structural changes were observed. It is suggested that the creep strength is due to the complete stability of the dispersed oxide phase up to the melting point of the matrix and also to the small stable grain size of the matrix. Heat treatments carried out above the melting point of the matrix have shown that a massive honeycomb network of oxide is produced. Author

N65-14148# Aeronutronic, Newport Beach, Calif.
TUNGSTEN AND MOLYBDENUM OXIDATION KINETICS AT EXTREMELY HIGH TEMPERATURES Final Report, 1 Jul. 1962 – 1 Jul. 1964
R. W. Bartlett Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1964 71 p refs
(Contract AF 33(657)-8654)
(ML-TDR-64-290; U-2712; AD-609108)

The oxidation rates of polycrystalline tungsten were measured at temperatures from 1300°C to near the melting point and at oxygen pressures from 10^{-6} atm to 1 atm. The role of an inert gas diluent in depressing the oxidation rate was also determined. The influence of forced convection from a hypersonic oxygen–argon stream on the oxidation rate was measured and correlated with forced convection theory. Variation in the reaction probability with different tungsten crystal faces was determined using oriented single crystals. Differences in the surface morphology of tungsten faces after oxidation, and the role of imperfections were observed. The oxidation rates of polycrystalline molybdenum were measured at temperatures to near the melting point at the same oxygen pressures, using the same experimental methods employed in the initial tungsten study. Author

N65-14222# IIT Research Inst., Chicago, Ill. Technology Center
INTERFACE FRICTION IN HOT METAL DEFORMATION Bimonthly Report, Sep. 24–Nov. 23, 1964
J. H. Schey 22 Dec. 1964 10 p refs
(Contract NOw-64-0458-F)
(IITRI-B6027-3; AD-454402)

The objective of this program was to investigate frictional phenomena encountered at the tool-workpiece interface during the hot deformation processing of metals. Work centered around the establishment of a reference base and the compression of 7075 Al with 1090, 4340, H-11, WC (10%Co), TZM, and Al_2O_3 anvils. Exploratory experiments with 4340 and 4130 steels and Inconel X750 were also conducted. Author

N65-14226# Atlantic Research Corp., Alexandria, Va.
BEHAVIOR OF NOZZLE MATERIALS UNDER EXTREME ROCKET MOTOR ENVIRONMENTS Second Quarterly Progress Report, Aug.–Oct. 1964
James D. Batchelor, J. B. Murphy, and E. L. Olcott Nov. 1964 15 p
(Contract NOw-64-0393-c)
(AD-609055)

Further work was carried out on two experimental techniques using the plasma-torch heat source. The test technique which exposes the bore of a tubular specimen to a high heat flux and a high velocity of selected gas mixtures was instrumented, and operating conditions were studied. The technique was improved as a means of studying chemical reactions. Additional tubular specimens of refractory carbides are in preparation. The plasma-torch impingement test method was used to obtain data for Graphitite GX specimens comparable to data published previously for other graphites. Author

N65-14233# New England Materials Lab., Inc., Medford, Mass.
HIGH TEMPERATURE DEFORMATION AND FRACTURE BEHAVIOR OF METALS UNDER HIGH STRAIN RATE CONDITIONS Final Report
J. M. Dhosi, R. Widmer, and N. J. Grant Oct. 1964 67 p
(Contract NOw-63-0502c)
(AD-452455)

Use was made of high-strain-rate tensile and stress-rupture tests for the determination of the deformation and fracture behavior of a superalloy, beryllium and tungsten. A pneumatically operated machine was used allowing very high loading rates without overload. Tests were run on all three materials over a wide range of strain rates and temperatures. Ductility in terms of total elongation and reduction in area was evaluated as a function of strain rate and temperature. On this basis, temperature ranges with best deformability were defined, and tends in ductility with changing strain rate were established. It was possible to determine, for each material, conditions with poor deformability. Some of the results are of a general nature, and an attempt was made to explain the behavior patterns in terms of the response of a given type of metal to high-strain-rate deformation. Correlations are made between the behavior under high-strain-rate testing conditions and actual hot-working operations. Author

N65-14256# Joint Publications Research Service, Washington, D.C.
PHYSICAL METALLURGY OF TITANIUM
7 Jan. 1965 74 p refs Transl. into ENGLISH from the publ. "Metallovedeniye Titana", Works of the Fifth Conf. on the Met., Phys. Met., and Appl. of Titanium and its Alloys (Mar. 1963) Moscow, Inst. of Met., 1964 p 177–183, 227–235, 240–242, (JPRS-28176; TT-65-30080) OTS: $3.00

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6. SUBMERGED DOUBLE-ARC WELDING OF MEDIUM AND LARGE THICKNESS SEMIFINISHED PRODUCTS OF TITANIUM ALLOYS S. M. Gurevich and S. D. Zagrebenyuk p 56–62

7. STUDY OF THE MUTUAL DIFFUSION OF TITANIUM WITH COPPER AND OTHER METALS SUITABLE FOR BRAZING A. Ya. Shinyayev, V. V. Bondarev, and Ye. V. Sergeyeva p 63–69 refs

N65-14290# Wien U., (Austria). Physikalisches Inst.
INVESTIGATION OF THE EFFECTS OF ULTRASONICS ON THE DEFORMATION CHARACTERISTICS OF METALS Interim Report, May 1–Jul. 31, 1964

[1964] 12 p refs
(Contract N62558-3436)
(IR-5)

Tests were made to determine the significance of an ultrasonic vibration of the die for the dynamic conditions of wire drawing. During these tests the die was placed in the stress antinode of a stationary wave, whose direction of vibration was perpendicular to the direction of drawing. A considerable amount of drawing force was saved by using ultrasonics. With lead the advantages of drawing with the die being excited by irradiation are pointed out even with regard to a material of especially high plasticity. Experiments indicate that the incubation time of recrystallization of cold-worked commercial zinc is increased by superimposed ultrasonics of high intensity. Superposition of high energy ultrasonics during previous storage of the deformed sample at room temperature leads to a longer incubation time during subsequent recrystallization at 55° C. Author

N65-14294# Naval Research Lab., Washington, D.C. Metallurgy Div.
EFFECTS OF NEUTRON IRRADIATION ON THE PROPERTIES OF REACTOR STRUCTURAL MATERIALS
L. E. Steele, J. R. Hawthorne, and C. Z. Serpan, Jr. 20 Jan. 1964 19 p refs
(Contract AT(49-5)-2110)
(NRL-MEMO-1502; AD-433152)

Four areas of research are summarized: (1) the determination of high-energy neutron exposure to reactor pressure vessels utilizing the Mn^{54} isotope analysis; (2) the evaluation of various steels in terms of radiation sensitivity; (3) the assessment of the effects of nuclear environmental conditions and service stress conditions as factors in irradiated steel behavior; and (4) determination of the influence of thermal environment (during and after irradiation) on the neutron embrittlement of reactor steels. Author

N65-14299*# General Electric Co., Philadelphia, Pa. Spacecraft Dept.
GRAVITY GRADIENT ROD THERMAL BENDING TEST REPORT
William G. Benton, E. M. Mazur, and R. J. Katucki 23 Oct. 1964 145 p refs *Its* Rept.-64SD4368
(Contract NAS2-1946)
(NASA-CR-60082) OTS: HC $4.00/MF $1.00

Detailed analytical studies were made of the temperature gradient in a beryllium copper gravity-gradient rod under near-earth orbit thermal vacuum conditions. These results were used to develop a theory of thermal bending of the rod and to specifically predict both the amount of bending for a straight seam rod of eight-foot length and the angle of bending with respect to the sun–rod plane. A test program was then conducted to check out the predicted values of thermal deflection and variation of bending angle. An investigation of thermal bending was also performed by setting up and solving the governing shell equations for the problem. Further thermal bending investigations considered amount of bending deflection and angle of bending for an eight-foot long rod with seams twisted at various rates. Values for deflection and angle variation were obtained. Author

N65-14327# Aluminum Co. of America, New Kensington, Pa. Alcoa Research Labs.
FRACTURE TOUGHNESS, FATIGUE-CRACK PROPAGATION AND CORROSION CHARACTERISTICS OF ALUMINUM ALLOY PLATES FOR WING SKINS Quarterly Report, Sep. 3–Dec. 3, 1964
G. E. Nordmark, B. W. Lifka, and J. G. Kaufman 15 Dec. 1964 52 p
(Contracts AF 33(657)-11155; AF 33(615)-2012)
(AD-453733)

The fracture toughness, fatigue properties and corrosion resistance of 2020-T651, 2024-T851, 2219-T851, 7001-T75, 7075-T651, 7075-T7351 and 7079-T651 plate are being determined. The results of control tests are given. A considerable number of fatigue crack propagation data were developed for 2024-T851, 7075-T651, 7075-T7351 and 7079-T651. The data indicate that 2024-T851 and 7075-T7351 have lower rates of fatigue crack propagation than 7075-T651 and 7079-T651. Corrosion data developed continue to show the superiority of 2024-T851 and 7075-T7351, which are completely resistant to exfoliation attack and stress–corrosion cracking. Of the other two alloys in test, 7079-T651 shows a slight advantage over 7075-T651, primarily with respect to resistance to exfoliation. Author

N65-14330# Research Inc., Hopkins, Minn.
DEVELOPMENT OF A COMBINATION SPECTRA LOADING FATIGUE AND DYNAMIC HEATING SYSTEM FOR DETERMINATION OF COMPLEX LOAD-TEMPERATURE-TIME DESIGN DATA OF MATERIALS
Robert W. Churchill Wright-Patterson AFB, Ohio, Res. and Technol. Div., Apr. 1964 44 p refs
(Contract AF 33(616)-8124)
(RTD-TDR-63-4234; AD-605701) OTS: $3.00

This program involved the modification of a standard dynamic loading test machine, the addition of a high rate heating oven and the development of an automatic programer for both items. This test equipment is capable of programing slowly varying static loads, dynamic loads, and temperature, automatically through the use of arbitrary programs drawn on a curve following programer. Three programs are included: one for the upper load, one for the lower load, and a third for specimen temperature. The machine is capable of operating at speeds up to 5000 cpm, and is capable of applying one cycle at a time and holding a load during programed temperature fluctuations. The dual-elliptical-reflector infrared furnace is capable of applying specimen transient temperatures up to 3000° F and continuous temperature of 1800° F. The maximum combined load that can be applied to a test specimen is 13 227 pounds tension or compression. The maximum static load is 7936 pounds. The maximum high frequency load is ±551.15 pounds to ±6613 pounds and the maximum slow speed force (up to 40 cpm) is ±11 023 pounds. A detailed description of the test equipment and its operation are given. Author

N65-14334# Air Force Systems Command, Wright-Patterson AFB, Ohio, Foreign Technology Div.
THE CORRELATION BETWEEN INTENSITIES OF STRESS AND DEFORMATION IN THE THEORY OF PLASTICITY
A. Zilautss 28 Jan. 1964 10 p refs Transl. into ENGLISH from Latvijas PSR Zinatnu Akad. Vestis (Riga), no. 5, 1963 p 51–56
(FTD-MT-63-216; AD-602552) OTS: $1.00

Using the experimentally determined independence of the correlation between the intensities of stresses and deformations from the stress condition during the condition of simple loading, it was found that the function of local deformation is characteristic of the material and does not depend on the stress condition. The analytical expression of this function is taken in the form of a polynomial. A convenient method is given for the calculations of coefficients of the polynomial by a curve of simple tension. Author

N65-14368# Materials Research Lab., Inc., Richton Park, Ill.
WARM WORKING OF ARMOUR STEEL FOR INCREASED STRENGTH AND TOUGHNESS Final Technical Report
E. J. Ripling and R. S. Lindberg Aug. 1964 35 p refs
(Contract DA-11-022-ORD-3673)
(AD-450275)

Warm working by rolling at a reasonably high temperature (800° to 900° F) was found to be as effective as warm stretching in suppressing the transition temperature of Mn-Mo armor. The increase in Charpy V notch supertransition shelf height produced by retempering after stretching was also found in warm rolled longitudinal samples, but not in transverse ones. Tempering armor steel at a lower temperature (750° F) followed by working and retempering below this initial temperature produced a modest improvement in toughness with a concurrent large hardness increase. The warm-rolled hard steels appeared to have somewhat better ballistic penetration resistance than conventionally treated steel of the same hardness, provided the temperature was maintained during rolling. Further, the falloff in penetration resistance normally seen at material hardnesses of 400 BHN and above against matching projectiles was not apparent in tests on 415 BHN warm-worked plate. The worked plate also demonstrated excellent shock resistance at low temperatures.
Author

N65-14394*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
DETERMINATION OF THE WELDABILITY AND ELEVATED TEMPERATURE STABILITY REFRACTORY METAL ALLOYS Fifth Quarterly Report, 21 Jun.–20 Sep. 1964
G. G. Lessmann and D. R. Stoner [1964] 75 p ref
(Contract NAS3-2540)
(NASA-CR-54232; WANL-PR-P-005) OTS: HC $3.00/MF $0.75

Tungsten-inert-gas (TIG) sheet butt welds for a weld parameter study were completed for all of the available alloys except W-25Re and unalloyed tungsten. With the exception of a Ta-8W-2Hf alloy (T-111) and a Cb-5W-1Zr-0.2Y-0.06C alloy (AS-55), test data for the remaining alloys are presented. A summary of current bend test results is given. Electron-beam (EB) sheet butt welds for a weld parameter study were completed for all available alloys except AS-55 and unalloyed tungsten. Bend test data on two additional alloys, Cb-10W-1Zr-0.1C (D-43) and W-25Re, are presented. Unexpectedly high bend ductile–brittle transition temperatures were obtained for the W-25Re EB welds. A thorough evaluation of the high-vacuum annealing furnace performance under simulated long time aging conditions was made. Latex natural rubber gloves were evaluated for use on the TIG weld chamber and were found to be inferior to neoprene. Techniques were developed for gold–nickel brazing of platinum–platinum rhodium thermocouples into the high-vacuum annealing furnace feedthroughs. An inert gas cover protects the joint while brazing is done by induction heating.
D.E.W.

N65-14419# New York U., N.Y. School of Engineering and Science
DEVELOPMENT OF TOUGH, HIGH STRENGTH ALPHA BETA TITANIUM-BASE ALLOYS AT 240,000-260,000 psi YIELD STRENGTH LEVEL Quarterly Progress Report No. 6, 26 Sep.–25 Dec. 1963
P. A. Farrar and H. Margolin [1963] 14 p refs
(Contract DA-30-069-ORD-3690)
(WAL-TR-401/303-5; AD-450292)

In order to develop titanium alloys with higher ductilities and 0.1% yield strength in the range of 190 000 to 240 000 psi and with usable ductility in the range from 240 000 to 260 000 psi, thirty 8-pound ingots were melted and tested. Four alloys which showed promising properties in the 190 000- to 240 000-psi range as 8-pound ingots were remelted as 80-pound ingots for further evaluation as bar, plate, and sheet material. Mill-annealed properties of the sheet material ranged from 173 000- to 190 000-psi 0.2% yield strength with 17% to 15% elongation for the transverse properties, and 167 000- to 177 000-psi 0.2% yield strength with 12% to 10% elongation for the longitudinal properties. The compositions of an additional twenty-six 8-pound ingots, currently being evaluated, are listed.
Author

N65-14421# Boeing Scientific Research Labs., Seattle, Wash.
CALORIMETRY OF TRANSIENT PHENOMENA IN METALS AT LOW TEMPERATURES
Joachim C. Erdmann and James A. Jahoda Oct. 1964 47 p refs Presented at the 4th Thermal Conductivity Conf., San Francisco, 13–16 Oct. 1964
(D1-82-0384)

A method is described which has been applied to measure the thermal energy leaving a metal specimen at low temperatures under the following conditions of thermal excitation: generation of localized instantaneous heat sources associated with discontinuous slip during tensile deformation of copper–nickel alloy specimens at 4.2° K; uniform heating of copper–nickel and lead–indium alloy specimens at time-dependent rates due to preplastic and plastic tensile deformation at 4.2° K. The method is based on the observation of thermal transients associated with the heat release. The inertia of the thermometers is either eliminated or accounted for. The results obtained permit a discussion of the stored energy of plastic deformation of metals, and the energy dissipated by the bowing and breakaway of dislocations pinned by solute atoms in solid solutions.
Author

N65-14443# Mechanical Properties Data Center, Suttons Bay, Mich.
TITANIUM AND TITANIUM ALLOYS Inventory Report 622
Oct. 1964 10 p
(AD-607488) OTS: $1.00

The inventory represents a current accounting of all the test data on the mechanical properties of titanium alloys that are stored in the data processing system. In addition to the measured test results, information on test environment, material condition, material form, and test techniques is stored to supplement and define the test data. The inventory has been arranged according to the temperature of testing, and within these groups the counts are further spread on the basis of pretest conditioning and the presence or absence of a notch in the tested specimen. The elevated-temperature range includes all tests conducted at 100° F or over; the low-temperature group includes all tests conducted at less than 30° F; and room temperature includes tests conducted at temperatures of 30° thru 99° F. However, the majority of this group was tested at 70° to 90° F. Pretest conditioned specimens are those that have been subjected to any condition other than room temperature prior to testing, including preloads, abnormal temperature, and environment, or any combination of these.
Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-13445# Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Center
LAMINATES FOR HIGH TEMPERATURE Monthly Letter Report
J. H. Freeman Aug. 1963 5 p
(Contract AF 33(657)-9078)
(MLR-11; AD-608000)

After several long-time aging tests were completed, the final flexural strength values of the laminates were measured and found to range from 9800 to 14 300 psi for resin EI-2 and from 21 700 to 28 600 psi for resin I-8. Resin EI-2 was developed to try to introduce polyester cross links into aromatic imide polymers by means of pentaerythritol units incorporated into the polymer chain. Early promising results were obtained on hand-dipped sheets precured in a forced draft oven at 160° C, but subsequent results using either tower-treated cloth or hand-dipped sheets were significantly poorer. Work on several resins showed that laminates can be made by the technique described if limitations of press equipment or product design necessitate it. The preparation, lamination, aging test results, cross-link reaction effects, reagent purity effects, and electrical properties of laminates are reported for several other resins. D.E.W.

N65-13502# Monsanto Research Corp., Dayton, Ohio.
EVALUATION OF ELASTOMERS AS O-RING SEALS FOR LIQUID ROCKET FUEL AND OXIDIZER SYSTEMS Technical Documentary Report, Mar. 1963–Mar. 1964
Carmen L. Bellanca, Ival O. Salyer, and Jay C. Harris Wright-Patterson AFB, Ohio. AF Mater. Lab., Aug. 1964 92 p refs
(Contract AF 33(616)-8483)
(ASD-TDR-63-496, Pt. II; AD-607240)

The candidate elastomers were placed under compression in closed cells and exposed to the liquid and vapor of liquid rocket fuels and oxidizers for extended periods of time. Rate of fuel loss through the seal, and the change in physical properties of the seal materials were determined. Nitrogen tetroxide, mixed hydrazines, chlorine trifluoride, 90% hydrogen peroxide, Hybaline A-5, and pentaborane were tested in direct contact with the O-ring seals at 73° F. Metal clad and polyethylene encapsulated elastomeric O-rings were also tested for resistance to nitrogen tetroxide at 73° F. The effect of temperature on elastomer endurance was determined by exposing the O-rings to nitrogen tetroxide, mixed hydrazines, and hydrogen peroxide at 160° F. The effect of direct immersion in liquid rocket fuels on the physical properties of the seal materials was investigated by immersing promising O-ring candidates in nitrogen tetroxide, hydrogen peroxide, and mixed hydrazines. Author

N65-13545*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF ENVIRONMENTAL PARAMETERS ON THE PERFORMANCE OF LOW-DENSITY SILICONE-RESIN AND PHENOLIC-NYLON ABLATION MATERIALS
Ronald K. Clark Washington, NASA, Jan. 1965 38 p refs
(NASA-TN-D-2543) OTS: HC $2.00/MF $0.50

Thermal performance data were obtained for low-density phenolic-nylon and low-density silicone resin in a 2500-kW arc jet over a range of heating rates from 10 to 242 Btu/ft^2-sec (0.113 to 2.75 MW/m^2) and a range of aerodynamic shear stresses from 0 to 7.2 lb/ft^2 (0 to 344 N/m^2) at jet-stream oxygen concentrations ranging from 0% to 23%. With use of these data, analyses were made of the relative effect of environmental parameters such as heating rate, free-stream oxygen concentration, stagnation enthalpy, and aerodynamic shear stress on the performance of these materials. Author

N65-13610 California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.
MODULUS DETERMINATION OF POLYMERS AT LOW TEMPERATURES
W. G. Knauss *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 583–590 refs (See N65-13577 04-34)
(Grant NsG-172-60)

An apparatus was constructed to measure the Young's modulus at liquid nitrogen temperature by recording the load and deflection of a simply supported beam. The case of materials having different tensile and compressive moduli is discussed. For solid propellant materials the accuracy is found to be about the same as that encountered in small-strain dynamic shear tests. The relevance of low-temperature modulus measurements to the glassy modulus is discussed on the basis of experimental results. Author

N65-13882# Dow Chemical Co., Denver, Colo. Rocky Flats Div.
RESEARCH AND DEVELOPMENT: CERAMICS Quarterly Progress Report, Jul.–Sep. 1964
D. J. Kessel 23 Dec. 1964 20 p refs
(Contract AT(29-1)-1106)
(REP-490) OTS: $0.50

Hot-pressing techniques using the powdered compounds aluminum nitride and titanium boride are being studied in an effort to provide high density crucibles. Both uniaxial and semi-isostatic techniques are being considered. In two lots of aluminum nitride, the impurities promoted higher end-point densities. Potential sources of error in calibration measurements are being examined. In studies of the sintering behavior of CeO_2, a 99%-pure powder was partially characterized. In process studies for machining oxide ceramics in the unfired state, six different oxides were spray dried with 4.0% polyvinyl alcohol as a binder. The oxides were Al_2O_3, MgO, 85% Al_2O_3, ZrO_2, $ZrSiO_4$ and $MgAl_2O_4$. The spray-dried oxides were isostatically pressed into bars and their physical properties studied before and after firing at different temperatures. R.L.K.

N65-14081# Illinois U., Urbana.
AN INVESTIGATION OF THE MECHANICS OF FAILURE IN GLASS FIBER REINFORCED PLASTICS Final Summary Report
H. T. Corten Sep. 1964 5 p refs
(Contract Nonr-2947(02)(X))
(AD-608924)

Summaries of technical reports issued during the research program are used to describe the results. The areas of study are: (1) *Modes of Fracture of Filament Wound Glass–Resin Composites;* (2) *Strength of Glass Filaments;* (3) *Fracture of Epoxy Resin;* and (4) *Fracture Toughness of Parallel Filament Composite Plates.* D.S.G.

N65-14104# Columbian Carbon Co., Princeton, N.J. Technology and Planning Div.

CARBON BLACK FOR ORGANIC DEPOLARIZER BATTERIES Final Report, 1 Jul. 1963–30 Jun. 1964

M. T. Johnston and J. E. Smith [1964] 53 p refs

(Contract DA-36-039-AMC-03239(E))

(Rept.-4; AD-453418)

The effort consisted of a second statistical series on the 14R furnace. In this series the interaction between oil feed rate and auxiliary gas was explored further. Enrichment of the furnace air with oxygen and use of additives in the make oil were also assessed during the 14R furnace runs. A wide range of colloidal tests were performed on the carbon blacks resulting from this program. Only oil absorption was significantly associated with cell performance. No single variable studied in the last furnace series showed any significant correlation with organic cell performance, nor were there any significant two-factor interactions. A review of the entire experimental program shows that although relationships on the 14R furnace were somewhat obscure, blacks from it were generally superior to the 10S blacks, so the 14R is the preferred system. Service life of A-size primary cells tested to 0.9 volts at 16-2/3 ohms continuous load ranged from 19 to 27 hours. The better blacks matched but did not exceed the performance of HR-1670, the best previous direct furnace black. Author

N65-14228# General Electric Co., Evendale, Ohio. Advanced Engine and Technology Dept.

INFLUENCE OF STRESS CORROSION ON STRENGTH OF GLASS FIBERS

D. L. Hollinger, W. G. Kanetzky, and H. T. Plant 30 Sep. 1964 12 p

(Contract Nonr-4486(00) (X))

(BMPR-3; AD-607040)

Initial static fatigue tests at liquid nitrogen temperature on single filaments of E-glass yielded incomplete data because of frost buildup problems. It became necessary to isolate the equipment from room humidity. This has been done, and low temperature testing has resumed successfully, with delayed failure data accumulating at a satisfactory rate. The results so far indicate that even with the very high rates of loading used in these tests, the stress level at which most fibers will fail immediately is lower at room temperature and normal humidity than at liquid nitrogen temperature. Gradually raising the temperature from liquid nitrogen temperature causes the failure of fibers which have been supporting a given load at −196° C. The implication is that the processes involved in static fatigue are greatly slowed down, but not completely eliminated, by lower temperatures in the range from room temperature to −196° C. Author

N65-14300*# United Aircraft Corp., East Hartford, Conn. Research Labs.

TABLES OF THE COMPOSITION, OPACITY, AND THERMODYNAMIC PROPERTIES OF HYDROGEN AT HIGH TEMPERATURES

N. L. Krascella Washington, NASA, 1963 190 p refs Also published as B910168-1

(Contract NAS3-3382)

(NASA-SP-3005; B910168-1) OTS: HC $3.00/MF $1.25

Tables are presented of the following theoretical characteristics of hydrogen gas: composition (partial pressures of H_2, H, H^+, H^-, electrons, and quantum states 1 through 5 of H); opacity (total spectral absorption coefficient and Rosseland mean opacity); thermodynamic properties (enthalpy, free energy, and entropy); and ionization potential lowering. All data are tabulated for 14 total pressures between 1 and 1000 atmospheres and for 21 temperatures between 3000 and 200 000 R. Spectral absorption coefficients are tabulated for 33 wave numbers between 1000 and 400 000 cm^{-1} at each pressure and temperature. The equations employed in making the theoretical calculations are listed and typical examples of the tabulated data are presented in graphical form. Author

N65-14329# Forest Products Lab., Madison, Wis.

EFFECT OF PRE-CYCLIC STRESSES ON FATIGUE LIFE OF PLASTIC LAMINATES REINFORCED WITH UNWOVEN FIBERS

Kenneth H. Boller Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 32 p

(Contract AF 33(657)-63-358)

(ML-TDR-64-168; AD-606769) OTS: $2.00

The fatigue life of five types of plastic laminates, made of Scotchply epoxy resin and unwoven "E" glass fibers, was measured at two stress levels after damage had been programmed at either higher or lower stress levels. The laminates were made of three types of resin and two orientations of fibers: ±5°, and at 0° and 90° to the principal axis. The S-N curves are presented for these laminates from 1/4 cycle to 10 million cycles. Five replications of tests are presented to establish median fatigue lives at specific stress levels. The three specific stress levels were at approximately 40%, 60%, and 80% of their ultimate strength. In general, the results show that if these laminates are subjected to one or three cycles at the 80% level and then cycled to failure at the 40% or 60% level, the first cyclic stress does not significantly affect the fatigue life at the second stress level. The results show, for three of the five materials, that if these laminates are subjected to a program of cycles at the 40% stress level and then cycled to failure at the 60% stress level, the first cyclic stress significantly extends the fatigue life at the second stress level. Author

N65-14345# IIT Research Inst., Chicago, Ill. Solid Mechanics Div.

UTILIZATION OF REFRACTORY NONMETALLIC MATERIALS IN FUTURE AEROSPACE VEHICLES. PART I: REVIEW OF STRUCTURAL DESIGN TECHNIQUES FOR BRITTLE COMPONENTS UNDER STATIC LOADS Technical Documentary Report, Feb.–May 1963

Ralph L. Barnett Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Sep. 1964 132 p refs

(Contract AF 33(657)-8339)

(FDL-TDR-64-123, Pt. I; AD-607977)

A systematic review of structural design techniques for brittle materials is presented with particular emphasis on statistical fracture theories. The properties of both series and parallel statistical models are discussed, and a critical analysis is given for the experimental data which is available in the literature. The relationship of extreme value statistics to the fracture problem is thoroughly exploited. A survey of brittle test specimens and of design rules-of-thumb is included, together with a number of promising design philosophies. Author

N65-14422# General Electric Co., Schenectady, N.Y. Research Lab.

THE DEPENDENCE OF THE YIELD STRESS, THROUGH THE ELASTIC MODULUS, ON THE MOLECULAR ORIENTATION OF PLASTICS

R. E. Robertson Feb. 1964 20 p refs

(Rept.-64-RL-(3580C))

An isothermal constitutive relation between plastic strain rate, tensile stress, and molecular orientation is described for bisphenol-A polycarbonate. Because the relation correctly predicts the general features of the necking phenomenon, which is common to many polymers—both crystalline and amorphous—it is suggested that the relation is probably qualitatively correct for polymers other than polycarbonate. The form of the constitutive relation, in its dependence on molecular orientation, is then shown to arise principally from changes in the elastic modulus. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-13370# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
GRADIENT PROJECTION IN HILBERT SPACE Mathematical Note No. 306
A. A. Goldstein (Texas U., Austin) Jun. 1963 11 p refs
(DI-82-0266)

This note extends constructive techniques employed by Kantorovich and Altman for the minimization of quadratic functionals defined on a real Hilbert space H to the minimization of a twice differentiable functional defined on a closed linear manifold in H. The possible approximation of "well-behaved" nondifferentiable functionals by a differentiable functional is also discussed. Author

N65-13392# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
AN ALGORITHM FOR ANALYTIC CONTINUATION Mathematical Note No. 320
Peter Henrici Sep. 1963 19 p refs
(DI-82-0295)

Let an analytic function f of a single complex variable be defined in a neighborhood of a point z_0 by means of its Taylor series at z_0. A constructive method for the solution of the following problem is discussed: Suppose it is known that the function f can be continued analytically into a domain R of the complex plane. It is desired to compute the value of f at an arbitrary point $b \in R$. Author

N65-13397# Purdue U., Lafayette, Ind. Mathematical Sciences Div.
ON THE DISTRIBUTION OF THE LARGEST CHARACTERISTIC ROOT OF A MATRIX IN MULTIVARIATE ANALYSIS Mimeograph Series No. 22
K. C. Sreedharan Pillai Sep. 1964 21 p refs
(Contract Nonr-1100(26))
(AD-607098) OTS: $1.00

General expressions are given approximating, at the upper end, the cumulative distribution function of the largest of s number of nonnull characteristic roots. These expressions are used to compute the upper 5% and 1% points of the largest root for s = 8, 9, and 10. D.S.G.

N65-13420# RAND Corp., Santa Monica, Calif.
LINEAR COMBINATIONS OF NON-CENTRAL CHI-SQUARED VARIATES
Sheldon James Press Sep. 1964 17 p refs
(NSF GP-214)
(P-2983; AD-607191) OTS: $1.00

The problem considered is the determination of the distribution of T (a function of chi-squared) for fixed known values of the parameters. With a minor change in notation, the problem becomes equivalent to indefinite quadratic forms in noncentral normal variates. The distribution of positive definite quadratic forms in noncentral normal variates is treated; the probability density function of T is found in terms of the results from an earlier section of the paper; and the cumulative distribution function of T is developed for percentage point computations. D.E.W.

N65-13421# RAND Corp., Santa Monica, Calif.
A CONFIDENCE INTERVAL COMPARISON OF TWO TEST PROCEDURES PROPOSED FOR THE BEHRENS-FISHER PROBLEM
S. James Press Oct. 1964 20 p refs
(NSF GP-214)
(P-2999; AD-607267) OTS: $1.00

The procedures of Scheffé and of Welch are compared according to the expected lengths of the confidence intervals they yield, and a criterion is developed for deciding which of the two methods is better in any given situation. An expression for the expected length of the confidence interval for the Scheffé procedure was developed. Because of the asymptotic series nature of the Welch procedure, in this case, the analogous expression is more involved; it is developed in this paper. Graphs are provided to summarize the numerical results. In large samples, the two procedures are equivalent. Author

N65-13441# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FORMULA FOR REPRESENTING THE PRODUCT OF ORIGINALS
V. Ya. Natanzon 16 Apr. 1964 6 p ref Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 20, no. 9, 1956 p 671-672
(FTD-MT-63-305; AD-605898)

Formulas are derived for the Laplace transform of a product of two or more functions of one variable. E.B.W.

N65-13442# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOLUTION OF THREE PROBLEMS IN THE LATTICE THEORY
S. A. Kogan 17 Apr. 1964 11 p refs Transl. into ENGLISH from Usp. Mat. Nauk (Moscow), v. 11, no. 2 (68), 1956 p 185-190
(FTD-MT-63-318; AD-605606)

Proofs are presented for the following theorems encountered in lattice theory: (1) In order that an element of a complete lattice be isolated in topology of ordering, it is necessary and sufficient that it be neither the least upper nor the greatest lower bound for any kind of chain, which is contained in its complement. (2) So that element a of a complete lattice L be isolated in an interval in topology, it is necessary and sufficient that, (i) in a set of elements, smaller than a there exists a finite subset of elements, including in totality all the elements of the set. (ii) for a set of elements larger than a the dual condition is satisfied, and (iii) in a set of elements, unincident (x is incident to y, y is incident to x) to a, there exists a finite subset of elements, incident in totality to all elements of the set. (3) For a structure L in

interval topology to be a Hausdorff space, it is necessary and sufficient that for each two different elements a_1 and a_2 of structure L in complement A of the sum of closed intervals $[-\infty, a_1 \cap a_2]$ and $[a_1 \cup a_2, +\infty]$ there exists a finite subset, the elements of which are incident in the aggregate to all elements of set A. P.V.E.

N65-13538*# Martin Co., Baltimore, Md. RIAS Div.
AVERAGING METHODS FOR DIFFERENTIAL EQUATIONS WITH RETARDED ARGUMENTS AND A SMALL PARAMETER
Jack K. Hale [1964] 30 p refs
(Contracts NASw-845; AF 49(638)-1242)
(NASA-CR-59835) OTS: HC $2.00/MF $0.50

The extension of the method of averaging to differential equations with retardation relies heavily upon the theory of linear equations with constant coefficients. In ordinary differential equations, an understanding of oscillations in perturbations of linear equations with constant coefficients is most easily accomplished by the introduction of a coordinate system which exhibits, in an explicit manner, the behavior of the unperturbed equation on the subspaces corresponding to the eigenvalues with positive, zero, and negative real parts. Methods of accomplishing the same end for hereditary functional–differential equations are presented. D.S.G.

N65-13556# Stanford U., Calif.
ON STATIONARY SOLUTIONS OF A STOCHASTIC DIFFERENTIAL EQUATION
[1963] 124 p refs
(AD-602104) OTS: $4.00

Proofs are presented for inequalities concerning stochastic integrals, for totally bounded sets of stochastic processes, and for the approximate sum of a stochastic integral; these proofs are used to prove the existence of a one-sided solution of a stochastic differential equation. Also discussed are conditions for the existence of a stationary solution in terms of the one-sided solution, conditions for existence of a stationary solution in terms of the coefficients a(f) and b(f), the case where the coefficients satisfy the Lipschitz condition, and the possible stationary solutions of a stochastic differential equation of the Markov type under the Lipschitz condition. D.S.G.

N65-13575*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN EXPLICIT SOLUTION FOR LARGE SYSTEMS OF LINEAR DIFFERENTIAL EQUATIONS
Robert E. Cummings and Lyle R. Dickey 7 Oct. 1964 24 p refs
(NASA-TM-X-53079) OTS: HC $1.00/MF $0.50

A practical method of obtaining an explicit solution to an inhomogeneous system of linear differential equations with constant coefficients is described. The method is readily adaptable to solving large systems on high-speed digital computers and is particularly efficient when a large number of solutions are desired for the same set of equations with different initial conditions and forcing functions. The problem that often arises when large eigenvalues are present is overcome by a unique feature. The solution is obtained for an exceptionally small integration step, and a process is described whereby the step can be doubled. Successive applications of this process provide a solution over an interval which increases exponentially in size with each step, whereas the work involved increases only in a linear fashion. This is advantageous since standard techniques require that special provisions must be made for any system which has exceptionally large eigenvalues. Author

N65-13794# Radio Corp. of America, Princeton, N.J. RCA Labs.
THRESHOLD FUNCTIONS THROUGH n = 7 Scientific Report No. 7
R. O. Winder Oct. 1964 48 p refs
(Contract AF 19(604)-8423)
(AFCRL-64-925; AD-452952)

This report is an enumeration of the 2470 self-dual eight-argument positive canonical threshold functions, each specified by its Chow parameters, each listed with its minimal 1-realization, and each accompanied by statistics on the number of extremals and iterations involved in its solution, together with a coded indication of its symmetry. The table is ordered lexicographically by the Chow parameters to facilitate test synthesis by table lookup. Author

N65-13828*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DETERMINATION AND ANALYSIS OF NUMERICAL SMOOTHING WEIGHTS
Ronald J. Graham Washington, NASA, Dec. 1963 32 p refs
(NASA-TR-R-179) OTS: HC $2.00/MF $0.50

The purpose of this report is to present a systematic approach to the derivation and analysis of numerical smoothing weights. A detailed step-by-step analysis of the method is presented, and some actual results are illustrated. It is possible to compare almost all numerical smoothing procedures on the same basis by an extension of the method used in this paper. By using the method discussed, numerical smoothing formulas can be derived with specified characteristics for specific applications. Formulas that smooth and differentiate simultaneously can be derived by extending the concept discussed. Other related formulas can also be derived. The known characteristics of the data are assumed to be the frequency characteristics. Many times the significant characteristics are known or can be determined. In cases where they are not known the validity of applying any smoothing formula may be questioned. Author

N65-13831# Purdue U., Lafayette, Ind. Div. of Mathematical Sciences
ON THE ASYMPTOTIC THEORY OF FIXED-WIDTH SEQUENTIAL CONFIDENCE INTERVALS FOR THE MEAN
Y. S. Chow and Herbert Robbins (Columbia U.) Oct. 1964 17 p refs *Its* Mimeograph Ser. No. 30
(Contracts Nonr-1100(26); Nonr-266(59))
(AD-607101) OTS: $1.00

Let $x_1, x_2, \ldots$ be a sequence of independent observations from some population. A confidence interval of prescribed width 2d and prescribed coverage probability α for the unknown mean μ of the population can be determined if the variance σ^2 of the population is known. The case is considered in which the nature of the population, and hence σ^2, is unknown and no fixed sample size method is available. The object of the present note is to prove the following: *Theorem.* Under the sole assumption that $0 < \sigma^2 < \infty$,

$$\lim_{d \to 0} \frac{d^2 N}{a^2 \sigma^2} = 1 \text{ a.s.},$$

$$\lim_{d \to 0} P(\mu \in I_N) = \alpha \text{ (asymptotic "consistency")},$$

$$\lim_{d \to 0} \frac{d^2 EN}{a^2 \sigma^2} = 1 \text{ (asymptotic "efficiency")}.$$

D.S.G.

N65-13858*# Martin Co., Baltimore, Md. RIAS Div.
THE CONDITION OF REGULAR DEGENERATION FOR SINGULARLY PERTURBED LINEAR DIFFERENTIAL-DIFFERENCE EQUATIONS
Kenneth L. Cooke [1964] 2 p refs
(Contracts NASw-845; AF 49(638)-1242; Nonr-3693(00))
(NASA-CR-59986) OTS: HC $4.00/MF $0.75

An initial value problem is considered for a singularly perturbed differential–difference equation which is very general in the way in which the retardations occur, but which is very special in that it is scalar and linear, and has constant coefficients. Since the equation has constant coefficients, the problem is reduced to a study of the behavior of certain kernel (Green's) functions as functions of ϵ, and ultimately to the study of the distribution of zeros of the corresponding characteristic functions, which are exponential polynomials, with ϵ multiplying the highest powers of the variable. This paper may be regarded as dealing with the problem of perturbation of the zeros of exponential polynomials. D.E.W.

N65-13891 Oklahoma State U., Stillwater. Engineering Experiment Station
NONLINEAR SYSTEMS. PART I: LITERATURE SURVEY
Edwin J. Waller and Robert Raymond Reed Jan. 1963 67 p refs *Its* Eng. Res. Bull. No. 127
Available from Oklahoma State Univ.: $2.00

Literature was surveyed in all disciplines where nonlinear systems are found. The publications are classified in general by defining the mathematical models of the systems, with subclassification according to physical system. Disciplines included are mechanical dynamics, control systems, electrical networks, heat transfer, acoustical oscillations, structural dynamics, gas dynamics, fluid flow, and vibration theory. A comprehensive bibliography is included. R.L.K.

N65-13981# New York U., N.Y. Courant Inst. of Mathematical Sciences
SOME ABSOLUTELY CONTINUOUS OPERATORS I
P. A. Rejto Sep. 1964 38 p refs
(Contract Nonr-285(46))
(IMM-NYU-329; AD-607349) OTS: $2.00

Abstract conditions are formulated which assure that the part of an operator over a given interval is absolutely continuous. These conditions are verified for the operators $-(d^2/dx^2) + q(x)$ acting on the intervals $(-\infty, +\infty)$ and $[0, +\infty)$, respectively, provided that the function q dies out at infinity. Author

N65-13986# Virginia Agricultural Experiment Station, Blacksburg.
RESEARCH ON ORDER STATISTICS AND THE DESIGN OF EXPERIMENTS. THE LOGARITHMIC DISTRIBUTION Technical Report No. 58
Boyd Harshbarger and H. A. David Jun. 1964 100 p refs
(Grants DA-ORD-29; PHS G-5T1-GM-2-07)
(AROD-2763-17; AD-444229)

The logarithmic distribution has the probability law for a random variable X given by

$$\text{prob}(X = x) = f(x) = \alpha\theta^x/x \quad x = 1,2,\ldots,\infty$$

where $\alpha = -1/\log(1-\theta)$. This distribution has the single parameter θ, with $0<\theta<1$. The development and discussion of this distribution are traced historically, references to it in other published literature are gathered, and the distribution is thoroughly discussed. Areas considered include analytic properties, estimation of parameters, modes of generation, occurrence, and relation to other distributions. D.E.W.

N65-14011# Brown (D.) Associates, Inc., Eau Gallie, Fla.
RESEARCH IN MATHEMATICAL TARGETING. THE PRACTICAL AND RIGOROUS ADJUSTMENT OF LARGE PHOTOGRAMMETRIC NETS Final Report
Duane C. Brown, Ronald G. Davis, and Frederick C. Johnson Griffiss AFB, N.Y., RADC, Oct. 1964 144 p refs Prepared under subcontract for Geo Space Corp.
(Contract AF 30(602)-3007)
(RADC-TDR-64-353; AD-609069)

The problem of the rigorous simultaneous adjustment of large photogrametric blocks is reviewed, and extensions to an earlier theory are developed. Various matrix iterative approaches to the solution of the very large systems of normal equations characteristic of sizable photogrametric nets are investigated. The method of block successive over relaxation yields a practical and most satisfactory solution to this problem. Results of an extensive series of numerical simulations are reported. The successful application of the approach to a 23-photo strip of actual photography provides final confirmation of the validity and effectiveness of the solution. Author

N65-14099# Florida State U., Tallahassee.
A NOTE ON THE PAPER "TWO SEQUENTIAL TWO-SAMPLE GROUPED RANK TESTS WITH APPLICATION TO SCREENING EXPERIMENTS." THE DEVELOPMENT OF STATISTICAL METHODS FOR QUALITY CONTROL AND SURVEILLANCE TESTING. SUBJECTIVE TESTING AND QUALITY EVALUATION
Frank Wilcoxon and Ralph A. Bradley Jan. 1964 7 p refs
(Contract Nonr-988(08))
(TR-11; AD-605556)

A two-sided alternative to the null hypothesis for a sequential two-sample group rank-sum test is presented and applied to the study of ulcers in the stomachs of two populations of rats. The severity of the ulceration was judged by visual examination at autopsy, and rank numbers were assigned to the individual rats. The natural logarithm of the combined average of the rank-sum antilogs exceeded the critical value, and a decision to accept the alternative method was reached. G.G.

N65-14125# Purdue U., Lafayette, Ind.
ON ELEMENTARY SYMMETRIC FUNCTIONS OF THE ROOTS OF TWO MATRICES IN MULTIVARIATE ANALYSIS Mimeograph Series No. 23
K. C. Sreedharan Pillai Sep. 1964 15 p refs
(Contract Nonr-1100(26))
(AD-607099) OTS: $1.00

A lemma is proved to show that the moments of the (s − i)th elementary symmetric function (esf) in s nonnull characteristic roots, $\lambda_i (i = 1,2,\ldots,s)$, of a matrix in multivariate analysis can be derived from those of the ith esf. Using this lemma the first four moments of the (s − 1)th esf have been obtained from those of a first esf already known. Further, a second lemma is given showing that the moments of the (s − 1)th esf in the s characteristic roots, $\theta_i = \lambda_i/(1 + \lambda_i)$, are derivable from those of the first esf in the λ's. Upper percentage points (5% and 1%) are obtained for the distribution of the (s − 1)th esf in the λ's for s = 3 using the moment quotients. An example is given to illustrate the use of this criterion. Author

N65-14130# Park Mathematical Labs., Inc., Carlisle, Mass.
A MATHEMATICAL MODEL FOR INPUT-OUTPUT DEVICES II Scientific Report No. 6
John A. Riley Aug. 1964 60 p refs *Its* Rept.-2417-SR-6
(Contract AF 19(628)-2417)
(AFCRL-64-798; AD-607470)

The technical notion of diagram (as employed by the category theorists) is used to define the concept of abstract block diagram. The bulk of the report is concerned with the study of the collection D of block diagrams whose input–output functions belong to a preassigned function algebra. It is shown that D may be given the structure of substitution algebra by appropriate definitions of evaluation, substitution, and contraction operators. In addition, a brief survey is made of the current literature concerning general input–output systems. Author

N65-14135# Wisconsin U., Madison. Mathematics Research Center

A DYNAMIC INVENTORY SYSTEM

William G. Howe Jul. 1964 27 p
(Contract DA-11-022-ORD-2059)
(MRC-500; AD-608858)

A truly dynamic system is one which will adjust to changes in the parameters of the system. In the case of an inventory control procedure these parameters determine the frequency distributions of demand and of lead time. Optimization approaches assume them given along with runout costs, inventory carrying costs, etc. The parameters, the cost, and some decision rule combine to give an equation representing total cost, which is then minimized with respect to the decision rule. There are two difficulties with this approach; changes in the parameters do occur which invalidate the results and it is very difficult indeed to determine the costs in the model. The proposed servosystem attempts to avoid these two difficulties by not fixing any parameters (distributions) and by omitting any costs in the model, employing only some level of protection against runout. Author

N65-14136# Wisconsin U., Madison. Mathematics Research Center

DIFFERENCE METHODS FOR A NON-LINEAR ELLIPTIC SYSTEM OF PARTIAL DIFFERENTIAL EQUATIONS

G. T. Mc Allister Aug. 1964 13 p refs
(Contract DA-11-022-ORD-2059)
(MRC-504; AD-608859)

This paper proves the existence and uniqueness of non-negative solutions to the Dirichlet problem associated with the nonlinear elliptic system

$$\Delta u_k = b_k \prod_{l=1}^{m} u_l^{n_l}, \quad k = 1, \ldots, m \qquad (*)$$

where b_k and the Dirichlet data $u_k = \phi_k$ are nonnegative. An iteration scheme is proposed for solving the difference scheme associated with (*), and a bound on the error between any iterant and the solutions to the difference equations is established. Author

N65-14138# Wisconsin U., Madison. Mathematics Research Center

AN ASYMPTOTIC LOWER BOUND FOR THE ENTROPY OF DISCRETE POPULATIONS WITH APPLICATION TO THE ESTIMATION OF ENTROPY FOR UNIFORM POPULATIONS

E. B. Cobb and Bernard Harris Oct. 1964 13 p refs
(Contract DA-11-022-ORD-2059)
(MRC-516; AD-608855)

An asymptotic lower bound is obtained for the entropy of a multinomial population with an unknown and perhaps countably infinite number of classes. This bound is a function of the first $k + 1$ occupancy numbers of a random sample and is a useful estimator when most of the sample information is contained in the low-order occupancy numbers. Author

N65-14139# Wisconsin U., Madison. Mathematics Research Center

REGULARLY VARYING FUNCTIONS AND THE PRINCIPLE OF EQUICONTINUITY

B. Bajsanski and J. Karamata Oct. 1964 21 p refs
(Contract DA-11-022-ORD-2059)
(MRC-517; AD-608856)

The concept of regularly varying functions is extended from real functions of a real variable to mappings of one topological group with a filter into another. The classical results on regularly varying functions are generalized, and one of these generalizations contains as a particular case the equicontinuity principle (or Banach–Steinhaus theorem). For the case of regularly varying functions of n real variables, the representation theorem is given. Author

N65-14140# Wisconsin U., Madison. Mathematics Research Center

AREA AND MOMENT OF INERTIA THEOREMS FOR CIRCULAR DOMAINS IN C^n

Josephine Mitchell Nov. 1964 22 p refs
(Contract DA-11-022-ORD-2059)
(MRC-522; AD-608852)

A Bieberbach area theorem for the unit disk is generalized to circular domains D in the space C^n of n complex variables. The holomorphic mapping (1) $w_j = f_j(z_1, \ldots, z_n)$ $(1 \leq j \leq n)$ maps D onto a domain whose volume is in general larger than that of D. Equality occurs for domains D of finite volume if and only if the absolute value of the Jacobian is 1. If (1) is a volume-preserving, center-invariant, holomorphic transformation, it maps a complete circular domain D of finite volume with the property that $\int_D z_j \bar{z}_k dv_z = \delta_{jk} \alpha$ (α a positive constant) $(1 \leq j, k \leq n)$, onto a domain which in general has a larger moment of inertia with respect to the center than D. Equality occurs if and only if (1) is a rotation about the center. The Cartan domains satisfy the hypotheses of these theorems. These theorems generalize results of P. J. Myrberg for the hypersphere in C^2. Author

N65-14153# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Applied Mathematics Research Lab.

TABLES FOR THE STUDENTIZED LARGEST CHI-SQUARE DISTRIBUTION AND THEIR APPLICATIONS

John V. Armitage and P. R. Krishnaiah Oct. 1964 93 p refs
(ARL-64-188; AD-609588)

Let $x_1, \ldots, x_K$ be K independently distributed chi-square variates with n degrees of freedom, and let x_0 be another chi-square variate with m degrees of freedom distributed independently of the other x_i's. Then, the distribution of $= m\, x_{max}/n\, x_0$ where $x_{max} = \max(x_1, \ldots, x_K)$, is known to be the "studentized" largest chi-square distribution. In this report, two methods are proposed to evaluate the probability integral of u. Using one of these methods, upper 10%, 5%, 2.5%, and 1% points of the distribution of u are tabulated for K = 1(1)12, and n = 1(1)19 for different values of m. Various applications of these tables are also discussed. Author

N65-14163# Joint Publications Research Service, Washington, D.C.

USE OF BARYCENTRIC COORDINATES FOR SOLVING SOME COMPUTATIONAL PROBLEMS

S. S. Lavrow 7 Jan. 1965 12 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 4, no. 5, 1964 p 905–911
(JPRS-28180; TT-65-30084) OTS: $1.00

By using barycentric coordinates, it is possible to obtain simple formulas and effective algorithms for solving a number of computational problems for functions of several variables, such as interpolations of functions, solutions of systems of nonlinear equations, and obtaining extrema of functions.
Author

N65-14178*# Analytical Mechanics Associates, Inc., Uniondale, N.Y.
AN ENSEMBLE AVERAGING APPROACH TO OPTIMAL GUIDANCE POLYNOMIAL APPROXIMATIONS
Henry J. Kelley and Walter F. Denham Nov. 1964 23 p refs
(Contract NAS8-11241)
(NASA-CR-60066) OTS: HC $1.00/MF $0.50

An approach to optimal guidance synthesis is developed in which an ensemble-averaged second-order approximation to the performance function is minimized subject to constraints on the means and variances of other functions. The minimization is with respect to coefficients of assumed polynomial approximations of a linear feedback control law (in which the state is perfectly known) and coefficients in a linear termination law. A brief comparison is drawn with deterministic neighboring extremal control. While attention is directed mainly to first-order necessary conditions, some comments are made on numerical solution by first- and second-order successive approximation methods. Extensions to include disturbances other than initial errors and to include state estimation errors are discussed briefly.
Author

N65-14184# Case Inst. of Tech., Cleveland, Ohio. Systems Research Center
MULTI-LEVEL APPROACH TO DYNAMIC OPTIMIZATION
Yasuhiko Takahara May 1964 162 p refs
(Contract Nonr-1141-12)
(SRC-59-A-64-21; AD-607913)

Multilevel systems theory is applied to linear dynamic optimization problems. The two main reasons for using a multilevel approach to optimization problems are that (1) this method eases the difficulty of computation of large scale optimization problems, and (2) this method may make control systems insensitive to disturbances. Reason (1) is considered in detail. The technique used is as follows. A large-scale control system is divided into smaller subsystems by the "decomposition technique," neglecting the interactions among the subsystems. The "higher level goal-seeking units" compensate for the neglected interactions through successive approximation. The convergence conditions of the successive approximation is treated.
Author

N65-14230# Oceanics, Inc., Plainview, N.Y.
THE NUMERICAL SOLUTION OF EIGENVALUE PROBLEMS
Theodore R. Goodman Nov. 1964 12 p refs
(Contract Nonr-4432(00))
(TN-64-06; AD-608558)

A new method for solving eigenvalue problems on a digital computer is presented, which is based on a procedure for solving two-point boundary-value problems. A general system of n linear, ordinary, homogeneous, differential equations is considered as

$$y_i = a_{ij}(t,\lambda)y_j, i = 1...n,$$

where the dot denotes differentiation with respect to the independent variable t, and it is understood that repeated indices are to be summed. The parameter λ is the eigenvalue to be determined. Suppose the boundary conditions to be such that at $t = 0$, r of the y_i's, viz.: $y_1(0)...y_r(0)$ are zero, and at $t = T$, $(n-r)$ of the y_i's, viz.: $y_{i_k}(T)$, $k = 1...(n-r)$, are zero. These homogeneous differential equations and boundary conditions constitute the eigenvalue problem.
Author

N65-14257# Joint Publications Research Service, Washington, D.C.
SOME METHODS OF ACCELERATING THE CONVERGENCE OF ITERATIVE SCHEMES
B. T. Polyak 7 Jan. 1965 19 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 4, no. 5, Sep.-Oct. 1964 p 791-802
(JPRS-28179; TT-65-30083) OTS: $1.00

The solution of the functional equation $P(x) = 0$ (where P is an operator, usually nonlinear, from B into B, B is a Banach space) usually uses iterative schemes, which are the construction of a sequence $x^0,...,x^n,...$, which converges in some sense to the solution. Also continuous analogs of these methods are known, in which a trajectory is constructed $x(t)$, $0 \leq t \leq \infty$, which satisfies an ordinary differential equation in B, and such that $x(t)$ tends to the solution of (1) when $t \to \infty$. A method is called a k-step method if, when constructing each successive iteration x^{n+1}, the k previous iterations $x^n,...,x^{n-k+1}$ are used. This terminology is also applied to continuous processes if $x(t)$ satisfies a differential equation of kth order. The most common iterative schemes are called 1-step (e.g. the method of successive approximations). These are usually simple from the computational point of view, however often converge slowly. This is true in estimating the rapidity of convergence and in actual computations. All methods given may be used for the minimization of the differentiable functional $f(x)$ in a Hilbert space, as the problem reduces to the solution of grad $(f(x)) = 0$.
Author

N65-14275# New York U., N.Y. Courant Inst. of Mathematical Sciences
ON INVARIANT SURFACES AND BIFURCATION OF PERIODIC SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS
Robert John Sacker Oct. 1964 101 p refs
(Contract Nonr-285(46))
(IMM-NYU-333; AD-607897)

Considered is the ordinary differential equation $dx/dt = F(x,\mu)$ where x is a real n-vector and μ is a real parameter. It is assumed that for all μ in a neighborhood of a critical value μ_1, this equation has a periodic solution $x = \psi(t,\mu)$ which is asymptotically stable for $\mu < \mu_1$ (n-1 Floquet multiples have modulus < 1). As μ increases through μ_1, a conjugate pair of multipliers, $\lambda(\mu)$ and $\bar{\lambda}(\mu)$, leaves the unit disc, causing ψ to become unstable. It is shown that a two-dimensional asymptotically stable invariant torus will bifurcate from ψ provided: (1) $\lambda(\mu_1)$ is not a second, third, or fourth root of unity; (2) $d/d\mu|\lambda(\mu_1)| > 0$; and (3) a certain nonlinear term obtained from $F(x,\mu)$ has the proper sign (nonlinear damping).
Author

N65-14289# RAND Corp., Santa Monica, Calif.
RATIO LIMIT THEOREMS FOR MARKOV CHAINS
Sidney C. Port Nov. 1964 59 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3995-PR; AD-607976)

In an irreducible, recurrent, Markov chain, with integer states, let $N_n(A)$ be the occupation time of A by time n, where A is a finite set of states. Various "ratio limit theorems" are investigated for $P_x(N_n(A) = k)$. Criteria are given for

various ratio limits to exist. The limits (when they exist) are shown to be expressible in terms of an integral over the set of integers E completed with its dual recurrent boundary $\hat{B}$. Applications are given to several specific Markov chains. Author

N65-14338# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING A SYSTEM OF FUNCTIONS
G. E. Kuzmak 16 Apr. 1964 13 p ref Transl. into ENGLISH from Mat. Sb. (Moscow), v. 35 (77), no. 3, 1954 p 461-468
(FTD-MT-63-316; AD-602588)

The following set of functions is considered:

$$\psi_0(x) = \left(1/\gamma_0\right) f(x),$$

$$\psi_{2m-1}(x) = \left(1/\gamma_{2m-1}\right)\left[1 + (f(x)/m)\sin mx\right] (m = 1,2,\ldots),$$

$$\text{and } \psi_{2m}(x) = \left(1/\gamma_{2m}\right)\left[1 + (f(x)/m)\cos mx\right].$$

The γ_n are determined from the condition of normalization of the ψ functions. A system of such a type is met in the theory of a wing of finite expanse during solution of an integro-differential equation for circulation; in this case f(x) depends on the form and dimensions of the wing. Author

N65-14339# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ONE THEOREM ON SERIES FOR POLYNOMIALS
T. I. Krasnoshchekov 17 Apr. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 77, No. 5, 1951 p 787-789
(FTD-MT-63-324; AD-605589) OTS: $1.00

Let the simply connected region G be bounded by the Jordan curve C and let the function $\omega = \phi(z) = z + \alpha_0 + \alpha_1/z + \alpha_2/z^2 + \ldots$ map in a one-to-one manner and conformally the region external to curve C, onto the region $|w| > r$. Then $\underline{r}$ is the transfinite diameter of the region G. Let C_R designate the curve in plane $\underline{z}$, which during the mapping of $w = \phi(z)$ changes to the periphery of $|w| = R > r$, and by G_R the region internal to it. Then, the transfinite diameter of region G_R equals R. The sequence of polynomials $P_0(z)$, $P_1(z)$,..... $P_n(z)$,... is considered, where $P_n(z) = z^n + \ldots + a_0^{(n)}$, for which the following condition is fulfilled: for any $\underline{n}$ and $R > r$ for points $\underline{z}$, lying on C_R, $|P_n(z)| < M(R + \epsilon)^n$, where M is a constant depending on C_R and ϵ, and $\epsilon > 0$ is as small a number as desired. Author

N65-14340# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NONLINEAR CONFLUENCE ANALYSIS
N. P. Klepikov and S. N. Sokolov 7 May 1964 8 p refs Transl. into ENGLISH from Teoriya Veroyatnostey i ee Primeneniya (Moscow), v. 2, no. 4, 1957 p 473-475
(FTD-MT-63-331; AD-602579) OTS: $1.00

Nonlinear confluence analysis, necessary for the treatment of experimental data when all variables are subject to errors, is considered from the standpoint of the maximum likelihood method. The likelihood function is a product of curvilinear integrals of the respective distribution densities of each point of the curve. For a sufficiently small curvature and a normal error distribution, these integrals are evaluated approximately, resulting in distribution functions of the normal type but with modified weights and shifted experimental points. Thus, a confluent problem is reduced to an ordinary regressional one. Weight modifications and point shifts may be found by means of successive approximations. Author

N65-14374# RAND Corp., Santa Monica, Calif.
RELATIVE INVARIANTS AND CLOSURE
Richard Bellman and John M. Richardson Oct. 1964 15 p refs
(ARPA Order 189-61; ARPA SD-79)
(RM-4209-ARPA; AD-607795) OTS: $1.00

One of the basic problems of mathematical physics is that of replacing a nonlinear functional equation by a more tractable (analytically and computationally) linear equation. More generally, it is desirable to replace a system of nonlinear equations, often derived from a single equation by means of an orthogonal expansion in a parameter, with a system of linear functional equations. To treat this problem, a method was presented based upon the concept of relative invariants, and the use of the multidimensional Lagrange expansion theorem. Author

N65-14385# RAND Corp., Santa Monica, Calif.
ADAPTIVE SEGMENTAL DIFFERENTIAL APPROXIMATION
Richard Bellman and Brian Gluss Nov. 1964 13 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4314-PR; AD-607981)

A blend of dynamic programing, quasi-linearization, and differential approximation methods was used to estimate the parameters of the differential subcircuits of a black box and to estimate the times of switching from one to another, using only information provided by the output function, either at sample points or continuously. The extension of these results to an adaptive procedure is discussed, in which the computations are reduced as the number of switchings that are occurring becomes large, relative to the number of subcircuits present in the system. In the method used, there is an innate quality control on the approximation. The method may be further refined for electrical systems that are known to be linear. Author

N65-14386# RAND Corp., Santa Monica, Calif.
THE INFINITE SERVER QUEUE WITH COMPOUND RENEWAL INPUT
Sidney C. Port Oct. 1964 34 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4331-PR; AD-607794) OTS: $2.00

The basic model is described as follows. At times $T_1 < T_2 < \ldots < T_k < \ldots$, primary events occur. The times $W_k = T_k - T_{k-1}$ are to be independent, identically distributed, positive random variables with finite first moment EW_1. When the kth primary event occurs, it gives rise to X_k impulses, each of which lasts a certain duration. Let these durations be $Z_{k1}, \ldots, Z_{kX_k}$. Assume that the X_i are independent, identically distributed, nonnegative, integer-valued random variables with finite mean EX_1, and that the Z_{ij} are independent, identically distributed, positive random variables with finite mean EZ_{ij}. Finally, the sequences $\{W_i\}$, $\{X_i\}$, $\{Z_{ij}\}$ are assumed independent. Investigated are the stochastic processes $\xi(t)$, i.e., the number of impulses present at time t, and the process $\xi \propto (t)$, i.e., the number of impulses present at time t in the stationary process which develops after the system has been in operation for a long period of time. Author

N65-14438# System Development Corp., Santa Monica, Calif.
THE STATUS OF DEVELOPMENTS IN THE THEORY OF STOCHASTIC DUELS
C. J. Ancker, Jr. 1 Sep. 1964 26 p refs
(SP-1017/008/00; AD-450774)

A brief outline of the history, the principal features, and the major analytical results to date of the theory of stochastic duels is presented. Areas for future research and possible fields of application are also considered. The connection with other models of combat, such as Lanchester's equations and games of strategy, is discussed. A complete annotated bibliography is included. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-13422# Weather Bureau, Washington, D.C.
MOVEMENT AND DEVELOPMENT PATTERNS OF CONVECTIVE STORMS, AND FORECASTING THE PROBABILITY OF STORM PASSAGE AT A GIVEN LOCATION
Chester W. Newton and James C. Fankhauser Jan. 1964 57 p refs
(Contract ARDS-A-176)
(Rept.-22)

Studies of radar echoes disclose that, in typical severe convective situations, the movement of individual thunderstorms is poorly correlated with the direction of the mean wind in the cloud-bearing layer. When storms are classified according to their horizontal dimensions, however, some systematic features emerge in respect to their average behavior. When the wind veers strongly with height, the largest storms move as much as 60 degrees toward right of the mean wind, and the smallest ones move up to 40 degrees toward left. This behavior is consistent with theoretical expectations which suggest that in a strongly veered environment new convection is favored on the right-hand flank of the cloud system (relative to the mean wind direction), the influence of propagation from this source being greatest in the case of large storms. A simple expression is derived, on the basis of water vapor supply and demand requirements, relating the direction of storm movement to the storm diameter and to characteristics of the wind field. Author

N65-13835# Joint Publications Research Service, Washington, D.C.
COMPARISON OF AIR TEMPERATURE AND HUMIDITY MEASUREMENTS IN THE LAYER UP TO 1.5 KM BY A MECHANICAL METEOROGRAPH CARRIED ALOFT BY A HELICOPTER AND BY AN A-22-IV RADIOSONDE
V. I. Selitskaya Jan. 1965 9 p Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 154, 1964 p 85–89
(JPRS-28131; TT-65-30056) OTS: $1.00

Data are presented from synchronous ascents of radiosondes and from a meteorograph carried on a helicopter in the lower 1.5-km layer of the atmosphere. Discrepancies in the measurement of air temperature and humidity are explained most often by the fact that the radiosonde was often in clouds and the helicopter never flew in the clouds. Other reasons for discrepancies are given as differences in thermal lag between the two instruments, and erratic altitude measurements. D.E.W.

N65-13836# Joint Publications Research Service, Washington, D.C.
ON THE ACCURACY OF THE COMPUTATION OF THE RICHARDSON NUMBER AND THE PROBABILITY OF ZONES OF INCREASED TURBULENCE
M. V. Zavarina 7 Jan. 1965 22 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 161, 1964 p 46–59
(JPRS-28186; TT-65-30090) OTS: $1.00

Errors are considered in calculating the Richardson number depending upon the accuracy of measurement of the meteorological elements at various altitudes, and in calculating the probability of Richardson numbers $Ri \leq 1$, determined basically by inaccuracy of measurement of the wind. Errors in the calculation of Ri in the troposphere reach a large magnitude at even insignificant vertical shifts of the wind. These errors may have a strong effect in the calculation of the mean values of the Ri number, but have a smaller effect on the results of a comparison of the calculated value of Ri with its critical value. Probabilities of small values of Ri are calculated with adequate accuracy in accordance with long-range data from aerological observations. Author

N65-13953# France. Direction de la Météorologie Nationale, Paris.
WEATHER PATTERNS IN THE FRENCH ANTILLES. PARTICULAR CASE STUDIES [TYPES DE TEMPS AUX ANTILLES FRANCAISES. ETUDE DE CAS PARTICULIERS]
A. Theveneau, R. Martin, and G. Sinthe (Service Météorol. Du Groupe Antilles-Guyane) Sep. 1964 68 p In FRENCH
Its Monograph-31

The seasonal evolution of the Atlantic tropical anticyclone field determines the structure of the trade wind and the succession of the types of weather in the French Antilles. The relative stability of the winter and spring weather regimes, as well as the perturbed regimes in the East in the summer and autumn and in the winter seasonal cycle are discussed and charted. Two particular cases are discussed. Western thalwegs in altitude and time in the Lesse. Antilles, and the effects of the intertropical zone of convergence on raininess in the Lesser Antilles. M.P.G.

N65-13972# Travelers Research Center, Inc., Hartford, Conn.
GENERAL CIRCULATION RESEARCH Final Report
Barry Saltzman and M. Sankar Rao Oct. 1964 153 p refs
(Contract CwB-10763)
(Rept.-7462-132)

A general solution is obtained for forced, stationary, quasi-geostrophic perturbations in an atmosphere having the main zonal-average characteristics of the real troposphere and stratosphere. Special solutions for winter conditions along 45° N latitude are obtained for idealized representations of forcing due to internal sources and sinks of heat and due to lower boundary airflow over topography. The results show how the solutions depend on the spatial scale of the disturbances. For example, on the longwave side of a critical vector wave number corresponding to quasi-resonance, the disturbances forced by internal heating tilt eastward with height, thereby transporting heat southward, and tend to increase in amplitude above the tropopause into the high stratosphere. The reverse is true for waves smaller than critical. Comparisons with observations suggest that the real atmospheric mean waves are combinations of modes from the two regimes. Author

N65-14159# Joint Publications Research Service, Washington, D.C.
SOME CHARACTERISTICS OF CIRCULATION IN THE NORTHERN AND CENTRAL PARTS OF THE PACIFIC OCEAN ON THE BASIS OF OBSERVATIONS ABOARD THE RESEARCH VESSELS "A. I. VOYEYKOV" AND "YU. M. SHOKAL'SKIY"
V. R. Dubentsov 6 Jan. 1965 23 p refs Transl. into ENGLISH from Tr. Tsentral. Inst. Prognozov (Moscow), no. 137, 1964 p 68–82
(JPRS-28128; TT-65-30053) OTS: $1.00

This paper contains data giving information on the principal characteristics of the distribution of temperature and wind with height in the northern and central parts of the Pacific Ocean. Differences in temperature in the temperate zone and in the tropics were determined. Data on the mean vertical cross sections for the 180th meridian, constructed for different seasons, have provided more exact information on the position of the subtropical jet stream, and it was shown that the mean velocity on its axis over the ocean does not decrease appreciably. Data on the distribution of zonal wind components at different heights near the equator are presented. Author

N65-14160# Joint Publications Research Service, Washington, D.C.
RELATIONSHIP BETWEEN PROCESSES IN THE TROPOSPHERE AND THE LOWER STRATOSPHERE
A. A. Pavlovskaya 6 Jan. 1965 15 p refs Transl. into ENGLISH from Tr. Tsentral. Inst. Prognozov (Moscow), v. 137, 1964 p 11–20
(JPRS-28129; TT-65-30054) OTS: $1.00

Frequent displacements of the center of the stratospheric polar cyclone toward the northern part of East Asia are caused by the formation of deep pressure and thermal troughs in the troposphere in this part of the continent. The spread of warmer air into the high latitudes along the eastern periphery of this trough leads to a temperature increase in the eastern part of the Soviet sector of the Arctic and its Canadian sector, and as a result the pole of stratospheric cold does not coincide with the geographic pole, and there is a displacement in the direction of Greenland–Spitzbergen. Author

N65-14162# Joint Publications Research Service, Washington, D.C.
SOME RESULTS OF AN EXPERIMENTAL INVESTIGATION OF THE STRUCTURAL-ENERGY CHARACTERISTICS OF TURBULENCE IN CLOUDS
M. A. German 6 Jan. 1965 19 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 154, 1964 p 46–57
(JPRS-28134; TT-65-30059) OTS: $1.00

This article presents the principal results of computation of the structural-energy characteristics of turbulence in clouds. The computations were made on a Ural-2 electronic computer. Empirical relations were derived to express the relationship between turbulence characteristics and certain parameters of atmospheric stability. The computed data were used to investigate the relationship between the rate of dissipation of turbulent energy and the turbulence coefficient. Author

N65-14235# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NB 3.164 (NRL-94), (7 JULY 1964) Meteorological Data Report
Marjorie Mc Lardie Hoidale Aug. 1964 40 p refs
(ERDA-174; AD-454271)

Meteorological data gathered for the launching of Aerobee NB 3.164(NRL-94) are presented for ballistic studies. Author

N65-14236# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
NIKE-APACHE SPEEDBALL II (ROUND NO. 54 SN-20) 23 July 1964 Meteorological Data Report
H. M. Richart and H. L. Karns Aug. 1964 38 p
(ERDA-179; AD-454273)

Meteorological data collected for the launching of the Nike-Apache Speedball II, Round Number 54, SN-20, are presented along with resulting ballistic data. Author

N65-14237# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
NIKE-APACHE SPEEDBALL II (Round No. 57 SN 25) Meteorological Data Report
H. M. Richart Oct. 1964 44 p
(ERDA-193; AD-454274)

Meteorological data collected for the launching of Nike-Apache Speedball II, Round Number 57, SN 25, are presented for future ballistic studies. Author

N65-14238# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
ATHENA FLIGHT NUMBER 004 (28 SEPTEMBER 1964) Meteorological Data Report
Gordon L. Dunaway Oct. 1964 37 p
(ERDA-194; AD-454275)

Meteorological data gathered for the launching of Athena Flight Number 004 are presented in tabular form for ballistic studies. Author

N65-14239# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
NIKE-APACHE NICAP (ROUND NO. 010), (29 JULY 1964) Meteorological Data Report
Gordon L. Dunaway Oct. 1964 24 p
(ERDA-197; AD-454276)

Meteorological data collected for the launching of Nike-Apache NICAP, Round Number 010, are presented for future ballistic studies. Author

N65-14240# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
NIKE-APACHE SPEEDBALL II (ROUND NO. 58 SN 27), 17 SEPTEMBER 1964 Meteorological Data Report
H. M. Richart and S. F. Kubinski Nov. 1964 49 p
(ERDA-203; AD-454277)

Meteorological data collected for the launching of Nike-Apache Speedball II, Round Number 58, SN 22 are presented along with resulting ballistic data. Author

N65-14241# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
NIKE-APACHE SPEEDBALL II (ROUND NO. 59 SN 26), 24 SEPTEMBER 1964 Meteorological Data Report
H. M. Richart Nov. 1964 39 p
(ERDA-204; AD-454278)

Meteorological data collected for the launching of Nike-Apache Speedball II are presented for future ballistic studies. Author

N65-14242# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
NIKE-APACHE SPEEDBALL II (ROUND NO. 60 SN 27), 30 SEPTEMBER 1964 Meteorological Data Report
H. M. Richart and J. M. Sharpe Nov. 1964 56 p
(ERDA-205; AD-454279)

Meteorological data collected for the launching of Nike-Apache Speedball II, Round Number 60, SN 27, are presented along with resulting ballistic data. Author

N65-14243# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
ATHENA FLIGHT NUMBER 005 (3 OCTOBER 1964) Meteorological Data Report
Len E. Carter and Stan F. Kubinski Nov. 1964 44 p
(ERDA-206; AD-454355)

Meteorological data gathered for the launching of Athena Flight Number 005, Vehicle #D-001, are presented in tabular form for ballistic studies. Author

N65-14244# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
NIKE-APACHE SPEEDBALL II (ROUND NO. 63, SN 29) (8 OCTOBER 1964) Meteorological Data Report
Harris L. Karns Nov. 1964 60 p
(ERDA-207; AD-454356)

Meteorological data gathered for the launching of Nike-Apache Speedball II, Round Number 63, SN 29, are presented along with resulting ballistic data. Author

N65-14245# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
NIKE-APACHE SPEEDBALL II (ROUND NO. 62, SN-23) (8 OCTOBER 1964) Meteorological Data Report
Harris L. Karns Nov. 1964 39 p
(ERDA-208; AD-454357)

Meteorological data collected for the launching of Nike-Apache Speedball II, Round Nr. 62, SN-23, are presented along with resulting ballistic data. Author

N65-14246# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
NIKE-APACHE SPEEDBALL II (ROUND NO. 61, SN-28) 1 OCTOBER 1964 Meteorological Data Report
J. M. Sharpe and H. M. Richart Nov. 1964 43 p
(ERDA-209; AD-454358)

Meteorological data collected for the launching of Nike-Apache Speedball II, Round Number 61, SN-28, are presented along with the resulting ballistic data. Author

N65-14247# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NASA 4.116 GS, S/N NASA 106 (30 OCTOBER 1964) Meteorological Data Report
Gordon L. Dunaway and Marjorie Mc Lardie Hoidale Nov. 1964 38 p refs
(ERDA-212; AD-454359)

Meteorological data gathered for the launching of Aerobee NASA 4.116 GS, S/N NASA 106, are presented, along with calculated ballistic data. Author

N65-14248# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NASA 4.52 UG, S/N 121-3 (3 NOVEMBER 1964) Meteorological Data Report
Marjorie Mc Lardie Hoidale and Gordon L. Dunaway Nov. 1964 35 p
(ERDA-213; AD-454360)

Meteorological data gathered for the launching of Aerobee NASA 4.52 UG, S/N 121-3 are presented along with calculated ballistic data. Author

N65-14249# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
NIKE-APACHE SPEEDBALL II (ROUND NO. 64, SN 24) (28 OCTOBER 1964) Meteorological Data Report
Len E. Carter and Stan F. Kubinski Nov. 1964 37 p
(ERDA-214; AD-454361)

Meteorological data collected for the launching of Nike-Apache Speedball II, Round Number 64, SN-24, are presented along with resulting ballistic data. Author

N65-14250# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
ATHENA FLIGHT NUMBER 006 (6 NOVEMBER 1964) Meteorological Data Report
Len E. Carter and Gordon L. Dunaway Nov. 1964 32 p
(ERDA-232; AD-454362)

Meteorological data gathered for the launching of Athena Flight Number 006, Vehicle #C-004, are presented in tabular form for ballistic studies. Author

N65-14254# Joint Publications Research Service, Washington, D.C.
METHOD FOR INVESTIGATION OF THE TURBULENT REGIME OF THE BOUNDARY LAYER USING DATA FROM ACCELEROGRAPH RECORDS AT PAKHTA-ARAL'
P. A. Vorontsov and M. A. German 6 Jan. 1965 20 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 154, 1964 p 65–77
(JPRS-28133: TT-65-30058) OTS: $1.00

A method for computing the structural characteristics of airflow by using data recorded from an aircraft accelerograph

is discussed. Aviation now makes extensive use of aerial methods possible from the study of physical processes in the atmosphere, especially processes of the turbulent exchange of fluxes of heat, moisture, and momentum. Theoretical investigations of the influence of a turbulent medium on the flight of an aircraft have facilitated the development of investigations of atmospheric turbulence caused by use of an aircraft. This article derives certain airflow structural characteristics by using an electronic computer. Computations were made using data from records of aircraft overloads for PO-2 planes. This paper also gives more precise values of the coefficient of turbulent exchange computed by using the Lyapin–Dubov formula. Author

N65-14255# Joint Publications Research Service, Washington, D.C.

DISTRIBUTION OF CONDENSATION NUCLEI OVER THE UKRAINIAN METEOROLOGICAL POLYGON

Ye. S. Yelezneva 6 Jan. 1965 13 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 154, 1964 p 3–10

(JPRS-28135; TT-65-30060) OTS: $1.00

This article presents the results of observations of the distribution of condensation nuclei over the experimental polygon of the Ukrainian Hydrometeorological Scientific Research Institute, and it considers the change of the concentration of nuclei with height in the warm and cold seasons of the year under different weather conditions. Also given are the results of several horizontal flights of aircraft and the influence of industrial sources on the concentration of condensation nuclei at different heights. Author

N65-14258# Joint Publications Research Service, Washington, D.C.

PROBLEMS OF TURBULENT DIFFUSION IN THE SURFACE LAYER OF THE ATMOSPHERE

7 Jan. 1965 176 p refs Transl. into ENGLISH from Tr. Leningr. Gidrometeorol. Inst. (Leningrad), issue no. 18, 1963 p 3–201

(JPRS-28188; TT-65-30092) OTS: $5.00

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4. AN ALGORITHM FOR DETERMINING THE FIELD OF CONCENTRATIONS OF A PASSIVE CONTAMINANT IN A STRATIFIED ATMOSPHERE WITH A COMPUTER Ya. S. Rabinovich p 42–51 refs
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13. ON COMPUTING ATMOSPHERIC POLLUTION IN THE REGION OF A PROJECTED STATE REGIONAL POWER PLANT [GRES] N. A. Boldyreva and S. N. Kaplan p 135–151 refs
14. EXPERIMENTAL INVESTIGATIONS OF AIR POLLUTION IN THE REGION OF THE PRIBALTIYSKAYA STATE REGIONAL POWER PLANT N. I. Kramer and S. M. Ponomareva p 152–163 refs
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N65-14260# Joint Publications Research Service Washington, D.C.

ANALYSIS OF ERRORS AND A METHOD OF DEW-POINT MEASUREMENT

V. S. Dvas 11 Jan. 1965 15 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 150, 1964 p 152–160

(JPRS-28223; TT-65-30104) OTS: $1.00

The point is defined as the temperature that water vapor assumes in saturated air. The errors that may arise in the measurement of the dewpoint are analyzed, and may be eliminated by a sufficiently slow cooling of the hygrometer mirror and by employing various correction factors. Two methods for improving the accuracy of dewpoint measurements are suggested: (1) creating sources and outlets of heat that can insure the cooling and heating of the mirror in conformity with a rigorous dependence, thus allowing accurate computation of the measurement error; and (2) developing instruments in which the cooling and heating processes are symmetric, and in which the temperature lag of the mirror–thermometer system is the same for heating or for cooling. A method of dewpoint measurement based on the latter principle is proposed, using thermoelements based on the Peltier effect for heating and cooling. D.E.W.

N65-14262# Joint Publications Research Service, Washington, D.C.

CHANGES OF CLIMATE AND CLIMATE-FORMING PROCESSES

V. A. Bugayev 1 Jan. 1965 11 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 12, 1964 p 3–8

(JPRS-28236; TT-65-30110) OTS: $1.00

Three climate-forming processes are considered most important—atmospheric circulation, the terrestrial balance of insolation vs radiation, and the varied influences of the underlying surface. With a particular ground surface the two other principal climate-forming processes interact closely with each other and one or the other predominates, depending on the season and general geographic conditions. Several examples are given of the relative importance of circulation patterns and radiation balance. Two maps showing temperature anomalies in January and June 1960 in the Northern Hemisphere are discussed; in January the anomalies were large and covered large surface areas, whereas in June the temperatures were much closer to the 10-year moving averages over the whole map. Also, the anomalies were larger and more extensive nearer the pole. The predominance of atmospheric circulation in the winter and the predominance of radiative influences in the summer are surmised from the patterns of the anomalies. D.E.W.

N65-14272# Isotopes, Inc., Westwood, N.J.
PROJECT SPRINGFIELD REPORT
Edwin F. Danielsen Washington, Defense Atomic Support Agency, 15 Jul. 1964 107 p refs
(Contract DA-49-146-XZ-079)
(DASA-1517; AD-607980)

This report is concerned with the theory and confirmation of a stratospheric–tropospheric exchange which accompanies a folding of the tropopause. Air from the lower part of the cyclonic stratosphere is extruded to form a thin inclined layer in the troposphere. The Springfield data prove that the extruded tropospheric layers contain radioactivity concentrations typical of the stratosphere. Concentrations exceeding the tropospheric by one or two orders of magnitude were measured aboard WB-50 and RB-57 aircraft on specially vectored flight paths. The sharp change in concentrations at the boundaries also confirms that the folding process is predominately laminar, so it is appropriate to refer to the exchange as a transport rather than a diffusion process. The report contains as complete a description of the folding and transport process as is possible to date. Physical processes capable of mixing the radioactivity from the layers to the ground are also discussed, including their probable distribution with respect to the extruded layers. Author

N65-14276# Navy Electronics Lab., San Diego, Calif.
100-MILLIBAR CIRCULATION INDICES
V. R. Noonkester 23 Sep. 1964 99 p refs
(NEL-1241; AD-452777)

As part of the Laboratory's research program for the purpose of specifying ionospheric prediction models, a set of 10 orthogonal indices was derived. These indices describe the perturbations in the 100-mb circulation over the eastern United States for the period 1951 to 1958. The indices should prove useful to others engaged in atmospheric research who wish to perform regression analyses. Author

N65-14382# Travelers Research Center, Inc., Hartford, Conn.
WEATHER DATA PROCESSING RESEARCH AND DEVELOPMENT PROGRAM Monthly Progress Report, Sep. 1964
[1964] 17 p
(Contract CwB-10704)
(AD-606899)

Detailed plans for the preparation of computer programs were formulated for the REEP (Regression Estimation of Event Probabilities) forecasts to be prepared for six terminals. Probability forecasts will be of five categories of ceiling and five categories of visibility for 2, 3, 5, and 7 hours. A feasibility study of Digifax equipment was initiated; this study will involve plotting an actual station model or mockup of the wind barb, the geopotential height of the constant pressure surface, the temperature, the dewpoint, and the station call letters. Other studies described include *Subsynoptic Scale Processes Project, Approach Zone Weather Studies, Scale Analysis of Terminal Weather Variations, Prediction Technique Development, and Radar Applications in Terminal and Enroute Weather Forecasting.* D.S.G.

N65-14447# Weather Bureau, Las Vegas, Nev.
WEATHER AND SURFACE RADIATION PREDICTION, FALLON, NEVADA, OCTOBER 26, 1963 Final Report
A. N. Hull, R. W. Titus, and H. F. Mueller Jun. 1964 40 p refs
Sponsored by ARPA
(Proj. Shoal)
(VUF-1008; AD-607919) OTS: $2.00

The Weather and Surface Radiation Prediction Unit commenced preliminary weather observations at the SHOAL Site in August 1962. Sufficient data were collected to insure statistical significance. Commencing on D-30, a complete weather analysis and forecasting unit was in operation at the SHOAL Site. The weather facilities, observation schedules, detailed preshot weather and radiation forecasts, and their verification are discussed. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-13518# Autonetics, Anaheim, Calif. Systems Div.
RENDEZVOUS INJECTION GUIDANCE
T. L. Gunckel, II, K. V. Smith, and R. A. Wenski 27 Jul. 1964 29 p refs

A thorough investigation of rendezvous injection guidance was conducted with emphasis placed on determining the time to inject into the transfer orbit, steering the vehicle while thrusting, and determining the time for engine cutoff. Three steering laws were considered; namely, $\bar{V}_g \times \bar{V}_{g_i}$, $\bar{A}_T \times \bar{V}_g$, and holding the direction of $\bar{V}_g$ fixed in space. From computer simulations of various maneuvers using these steering laws, a simple guidance rule was derived (for computing current estimate of velocity-to-be-gained) which has a 5-second major cycle time and a guidance error of about 100 feet for near-earth orbits. This mechanization is explicit in form and requires the solution of the two-body equations of motion once each major cycle. Transfer orbits were restricted to have a perigee above the earth's atmosphere, so that in the event of equipment failure aborting the rendezvous, the vehicle's trajectory will not intercept the atmosphere. A simple, explicit rule for the time of thrust ignition yielding a minimum fuel transfer was derived from examination of two impulse transfers. Author

N65-13838# Philco Corp., Palo Alto, Calif. Western Development Labs.
NAVIGATION CONTROL SATELLITE SYSTEM Interim Study Report

Stanley F. Schmidt et al. 24 Jul. 1964 215 p refs
(WDL-8279)

The navigation/control system utilizes a network of satellites orbiting at medium or synchronous altitude. Each satellite has a dual purpose: to supply reference for user-measured fix, and to provide the communication link between user and control center for traffic control. Navigation is based on an angle-measurement concept. The reference information supplied by the satellite permits the user to make two time interval measurements which, when supplemented by the satellite ephemeris and orientation data, can be converted to downrange and cross-range angles. Described are the satellite-generated reference, transmission of satellite orientation and ephemeris data, traffic control communications, and system accuracy. The elements of satellite, control center, and user equipment are defined. System implementation is discussed in detail including satellite stability, satellite reference generation, user reception and detection, accuracy analyses, and fix computation. These analyses demonstrate that the concept is feasible relatively economical, and within state-of-the-art technology. R.L.K.

N65-13862# Joint Publications Research Service, Washington, D.C.
BRIEF DEVELOPMENTS IN SOVIET SPACE NAVIGATION
Leonid Byshko 5 Jan. 1965 6 p Transl. into ENGLISH from Trud. (Moscow), 15 Oct. 1964 p 2
(JPRS-28104; TT-65-30040) OTS: $1.00

To insure a successful manned space flight, a variety of scientific, technical, and medicobiological problems have to be investigated. The trajectories for the return, the thermal shielding, the construction of the space ship, and the environmental conditions for the astronaut himself are only a few of the many conditions that have to be considered. G.G.

N65-14319# Naval Research Lab., Washington, D.C. Applications Research Div.
THE COMPUTATION OF EFFECTIVE DISPLAY SENSITIVITY IN AIRCRAFT LANDING
Barbour Lee Perry 17 Jan. 1964 9 p
(NRL-6055; AD-430516)

In analyzing the altitude control loop in carrier landing, it is necessary to examine the geometry involved in the calculation of effective display sensitivity. This report describes the method of determining this gain for a deck-mounted display of glide path error. Of particular utility in comparing existing systems with one another or with proposed new systems is the concept of relative display sensitivity, which is the ratio of the effective display sensitivity of one display to that of another. Author

N65-14403# International Business Machines Corp., Rockville, Md.
COMPUTER PRECISION STUDY Final Technical Documentary Report, Jan.–Oct. 1964
Oct. 1964 293 p refs *Its* Rept.-64-504-005
(Contract AF 04(695)-462)
(SSD-TDR-64-292; AD-450555)

For near-earth and cislunar missions and for long periods of autonomous navigation, the navigation algorithms and the vehicleborne processor may introduce significant navigational error. Without performing tradeoffs of sensor and/or operational requirements, the purpose of the computer precision study was the evaluation of computer-generated error in processing the navigational algorithms for a typical near-earth and cislunar mission. The study objectives included the formulation of the navigation algorithms, the evaluation of both the numerical accuracy and theoretical accuracy of these algorithms, and the summary of the computational requirements. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-13373# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROTECTION OF TRANSPORT UNITS WITH NUCLEAR-PROPULSION ENGINES Selected Parts
V. Orlev and S. Tsypin, ed. 1 Oct. 1964 12 p Transl. into ENGLISH from the book "Zashchita Transportnykh Ustanovok s Yadernym Dvigatelem" Moscow, Izd. Inostrannoy Lit., 1961 p 5–11, 618–619
(FTD-TT-64-929/1; AD-607304)

In this collection are reports on calculation and experimental investigation of the passage of neutrons and gamma radiation in various protective media, used in transport nuclear-energy installations, and also on the study of radiation diffusion in media surrounding these installations. A part of the report is devoted to engineering problems—construction, assembly, selection of materials for the protection of ship installations, rockets, etc. Also given are certain experimental data and descriptions of installations, which can be used for the creation of a protective medium for a nuclear reactor for aircraft engines. Author

N65-13375# Hanford Atomic Products Operation, Richland, Wash. Physics and Instruments Lab.
NEUTRON DETECTOR SHIELDING IN A REACTOR BACKGROUND ENVIRONMENT
O. K. Harling Oct. 1964 13 p refs
(Contract AT(45-1)-1350)
(HW-84329) OTS: $1.00

Several detector shielding configurations of boron carbide, boric acid, cadmium, and water were studied for use in the experimental areas of a nuclear reactor. Their effectiveness, alone and in combination, as absorbers and as scattering-type shielding was measured, using crystal spectrometers and slow-neutron time-of-flight spectrometers as detectors. It was concluded that an optimal mixture of absorbers and scatterers provides better detector shielding than either type of material used separately. G.G.

N65-13446*# Lockheed Nuclear Products, Marietta, Ga.
EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES Quarterly Progress Report No. 15, July – September 1964
C. A. Schwanbeck et al. [1964] 45 p refs
(Contract NASw-114)
(NASA-CR-59928; ER-7604) OTS: HC: $2.00/MF $0.50

Thirty smooth and twenty-two notched tensile specimens were irradiated at 30° R. The specimens consisted of Rene 41, K Monel, Inconel, Inconel X (precipitation hardened), A-286 steel, AM 350 Steel, and 440C stainless steel. Factors studied

included: ultimate tensile strength, tensile yield strength, elongation, reduction of area, and fracture stress. The results obtained from nonirradiated and from irradiated specimens were compared. A significant irradiation-induced embrittlement was observable in AM 350 steel, and a measureable reduction in tensile strength was observed in 440C steel as a result of irradiation. P.V.E.

N65-13501# Atomics International, Canoga Park, Calif.
MATERIAL BUCKLINGS OF CRITICAL AND SUBCRITICAL URANIUM CARBIDE FUELED GRAPHITE ASSEMBLIES. PART I: EXPERIMENT
O. R. Hillig and D. W. Latham 1 Dec. 1964 69 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9771) OTS: $1.50

A series of critical and subcritical experiments have been performed to determine values of material buckling and k_{eff} for graphite assemblies fueled with slightly enriched (3.02 w/o), uranium-carbide fuel elements. Lattice arrangements have been studied that included control channel mockups for triangular lattice pitches of 9, 11, and 12 inches. Experiments have been performed to determine critical mass for two-region (uranium-carbide and uranium-metal-fueled) assemblies and k_{eff} for subcritical, uranium-carbide-fueled assemblies. Exponential experiments have been carried out to determine material buckling for subcritical assemblies containing uranium-carbide fuel elements. Material buckling and k_{eff} values have also been inferred from the two-region critical mass measurements using four-group theory, and these values have been compared to the results obtained from subcritical measurements. Author

N65-14182# Atomics International, Canoga Park, Calif.
SNAP 8—CONTROL-DRUM ACTUATORS
S. Giles and A. A. Marcus 15 Dec. 1964 30 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9645) OTS: $2.00

Design, development, and test results to date on electromagnetic actuators for the SNAP 8 control-drum drive system are summarized. The SNAP 8 actuator development is an extension of the earlier actuator development work performed for the SNAP 10 system. The environmental and operational requirements of the SNAP 8 system established the need for actuators which would perform reliably with greater torque, longer life, and tolerance to higher levels of irradiation, temperature, shock, and vibration. Three models are discussed: two indirect-drive models, the S8DRM-1 and S8DS actuators, and a direct-drive backup design, the 0.5° -step actuator, which has a high torque-to-volume ratio. Author

N65-14354# General Dynamics Corp., San Diego, Calif. General Atomic Div.
NUCLEAR PULSE PROPULSION
J. C. Nance 5 Oct. 1964 17 p Presented at the IEEE 11th Nuclear. Sci. Symp., 28–30 Oct. 1964 Submitted for Publication
(Contract AF 29(601)-6214)
(GA-5572; AD-450629)

Two fundamental advantages are given for use of propulsive nuclear explosives. First, there is no more compact energy source known to man. Second, impulsive application of energy provides a means of circumventing the thermal barriers inherent in other nuclear systems. Classes of nuclear-pulse propulsion engines, technical areas including the operating cycle of the ORION engine, status of past research efforts, engine design technology, and possibilities for performance improvement are discussed. An obvious and direct approach to improve performance is to use a larger propulsion system. No basic technology improvements are involved. Also, use of advanced high-strength materials in the pusher and shock absorbers would permit increased allowable pressures and higher engine thrust-to-weight ratios. It is concluded that the most thought provoking approach may derive simply from advancements in current knowledge of energy transport mechanisms. E.E.B.

N65-14371# Sandia Corp., Albuquerque, N. Mex.
RE-ENTRY FLIGHT DEMONSTRATION NUMBER TWO Interim Flight-Test Report
L. O. Cropp, W. H. Everhart, L. J. Keck, R. D. Klett, M. M. Robertson et al 8 Jan. 1965 89 p Sponsored by AEC
(SC-RR-65-13) OTS: $3.00

Reentry Flight Demonstration number two (RFD-2) was an operational safety flight test of systems for nuclear auxiliary power (SNAP). The SNAP test unit flown on the RFD-2 was an inert (nonradioactive) version of an isotopic generator. The disassembly design of the generator was investigated by monitoring the following events during reentry: destruction of the outer housing of the generator; destruction or separation of the thermoelectric or thermionic modules and insulating materials surrounding the generator; and exposure, ablation, and release of the simulated isotopic fuel in the generator. P.V.E.

N65-14434# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
ANALYSIS OF RADIATORS FOR SPACE NUCLEAR POWER SYSTEMS
Roy W. Blanton, Jr. Dec. 1964 45 p refs
(R-125)

A theoretical analysis is presented for designing heat radiators for space nuclear power systems. The analysis is for two configurations: conical, single-surface radiators, and flat, tapered plate radiators. Both condensing and noncondensing fluid conditions are considered. A FORTRAN IV program is included. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-13395# Syracuse U. Research Inst., N.Y. Coll. of Engineering
ON THE QUANTUM MECHANICAL ASPECTS OF THE WAVESHAPE OF ELECTROMAGNETIC RADIATION Technical Report No. 7
Gerard Lachs 8 Sep. 1964 57 p refs
(Contract Nonr-669(10))
(EE494-649T-7; AD-607104) OTS: $3.00

An outcome of the quantum mechanical description of the coherence properties of light has been the increased understanding of the coherent states of harmonic oscillators; these states form a natural connection between the quantum mechanical properties of electromagnetic radiation and signal waveforms.

One of the results obtained is an upper bound on the channel capacity where the only noise in the channel is due to the zero point field. The P-representation of a general state in terms of the coherent state is used to obtain the probability densities of the in-phase component, the quadrature component, the envelope, and the number of photons in the field. This is done for thermal radiation and for a mixture of thermal and coherent radiation, and the results show that thermal radiation behaves as pure Gaussian noise while the coherent radiation behaves as a classical signal. D.S.G.

N65-13565 Tufts U., Medford, Mass.
CONTINUOUS REPRESENTATIONS IN THE STATISTICAL THEORY OF ELECTRONIC ENERGIES. THE SELF-CONSISTENT FIELD
George S. Handler and Sidney Golden (Brandeis U.) 25 Sep. 1964 16 p refs
(Contract Nonr-1677(01))
(TR-11; AD-607287) OTS: $1.00

A self-consistent field approximation was applied to the continuous representation version of statistical theory. Calculations were carried out for He(^{3}S and ^{1}S), Be^{++}(^{1}S), Be(^{1}S), and Ne(^{1}S). Binding energies are about 6% greater than experimental values. No shell structure in electron density was obtained, however, which reflects an inadequacy of the theory in approximating such properties. Nevertheless, the densities obtained gave relatively good estimates of the mean values of r^n, $-2 \leq n \leq +2$.

N65-13624# ARO, Inc., Arnold Air Force Station, Tenn. Aerospace Environmental Facility
CRYOPUMPING OF CO_2 NOZZLE FLOW BY 77° K CRYOSURFACE
B. A. Mc Cullough and E. S. J. Wang Arnold Eng. Develop. Center, Jan. 1965 24 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-250; AD-453440)

Tests were conducted in an 8.25-in.-diam by 44.50-in. chamber utilizing 77° K walls to remove CO_2 gas glow. The CO_2 gas temperature was varied from ambient to 1680° F. A method was devised to estimate the capture coefficient of high-temperature CO_2, and the relationship was confirmed for various gas temperatures. Trapping of N_2 by CO_2 gas flow was accomplished at a ratio of 1 N_2 molecule to 10^5 CO_2 molecules. A significant amount of ejector action was observed for CO_2. Author

N65-13787# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT THE WIDTH OF THE ZONE OF BURNING OF A STATIONARY FLAME JET IN TURBULENT FLOW OF UNIFORM MIXTURE
A. V. Talantov 7 Apr. 1964 17 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 2, 1961 p 147–157
(FTD-MT-63-248; AD-607973)

The results of an experiment show that the axial extent of the zone of burning does not depend on the distance to the point of ignition. Since the speed of flow on the axis of the zone in the experiments during free expansion can be considered constant, then the constancy of the extent of the zone leads to the conclusion about the independence of the time of burning from the distance to the source of ignition. In accordance with the analysis, this conclusion leads to the independence of the width of the zone from x in cases when the conditions of expansion do not exert influence on the width of the zone. Author

N65-13806# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF VIBRATIONS
I. M. Babakov 1 May 1964 760 p refs Transl. into ENGLISH of the book "Teoriya Kolebaniy" Moscow, Gos. Izd. Tekhniko-Teoretich. Lit., 1958 p 3–628
(FTD-63-738/1+2; AD-601548)

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N65-13916 Joint Publications Research Service, Washington, D.C.
BEAM DESCRIPTION OF WEAKLY-INHOMOGENEOUS WAVE FIELDS
L. S. Dolin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 244–249 refs (See N65-13892 04-07) OTS: $6.00

The correlation function for a randomly inhomogeneous monochromatic field is given in a form such that it may be considered as the Fourier component of a certain self-correlation function. The boundary-value problem for the equations describing this correlation function is considered. A transport equation is derived that describes the propagation of radiation with an allowance for certain diffraction effects. D.E.W.

N65-13968# Technische Hochschule Darmstadt (W. Germany).
THE INFLUENCE OF PERIODICAL INTERFERING BODIES OF LOW DIELECTRIC CONSTANCY ON THE PHASE MODES OF HOLLOW WAVEGUIDES [DER EINFLUSS VON PERIODISCHEN STORKORPERN MIT KLEINER DIELEKTRIZITATSKONSTANTE AUF DAS PHASENMASS VON HOHLLEITERWELLEN]
Robert Willett (Ph.D. Thesis) [1964] 56 p refs In GERMAN

Presented is an approximation analysis of the phase mode of an ideal smooth waveguide that is interrupted periodically by interfering bodies. The method is applicable as long as the value of the dielectric parameter E_r for the material of the interfering body is below 1.05. This leads to the consideration of styrofoam ($E_r = 1.03$) as a supporting structure material for waveguides. G.G.

N65-14259# Joint Publications Research Service, Washington, D.C.
DEPENDENCE OF DISPERSION OF PARTICLES EMITTED BY A CONTINUOUS SOURCE ON THE DURATION OF THE EXPERIMENT
E. K. Byutner 11 Jan. 1965 13 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 150, 1964 p 78–84
(JPRS-28221; TT-6530102) OTS: $1.00

An expression was derived for a finite interval for the mean dispersion of particles emanating from a continuous source. The dispersion is dependent not only on the Lagrange correlation function of particle velocity, but also on the correlation between the velocities of particles emitted one after the other at the interval τ from the source and carried for different times in the turbulent field. It is shown that the formula for dispersion obtained by Ogura is incorrect. Author

N65-14318 Naval Research Lab., Washington, D.C. Sound Div.
ANALYTIC FORMULAS FOR THE ACOUSTIC PRESSURE DISTRIBUTION BETWEEN A SPHERICAL TRANSDUCER AND A CONCENTRIC SPHERICAL BAFFLE Interim Report
S. Hanish 17 Jan. 1964 10 p refs
(NRL-6018; AD-435480)

A sphere with arbitrary distribution of normal velocity over its surface and partially surrounded by a spherical baffle board radiates sound into infinite space. In the region between the radiating sphere and the baffle board, the resultant sound field consists of a set of incoming and outgoing waves that are described by an appropriate set of spherical wave functions. These functions are adjusted to yield a normal component of particle velocity distribution which matches the velocity distribution at the surface of the sphere. In the region outside the baffle, the sound field corresponds to outgoing waves only. At the junction of the inner and outer regions over those portions of arc where no baffle exists, the condition of continuity requires that pressures and particle velocities agree as the boundary is crossed. This requirement of continuity equates the infinite series of spherical wave functions in the outer region to an infinite series of different spherical wave functions in the inner region. The result is an infinite set of simultaneous equations in an infinite set of unknown expansion constants.
Author

N65-14333# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DOPPLER EFFECT AT VELOCITIES GREATER THAN THE SPEED OF LIGHT
V. L. Ginzburg and I. M. Frank 22 Apr. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 56, No. 6, 1947 p 583–586
(FTD-MT-63-187; AD-602596) OTS: $1.00

In the complex doppler effect, the frequencies of radiation of the atom satisfy the conditions:

$$\omega = \frac{\omega_0 \sqrt{1-\beta^1}}{1-\beta n(\omega)\cos\theta} \text{ at } \beta n(\omega)\cos\theta < 1, \text{ and} \quad (1)$$

$$\omega = \frac{\omega_0 \sqrt{1-\beta^2}}{\beta n(\omega)\cos\theta - 1} \text{ at } \beta n(\omega)\cos\theta > 1, \quad (2)$$

where θ is the angle between the normal to the wave, i.e., between the beam and the velocity of the atom $\overline{v}$, $\beta = v/c$, ω_0 is the natural frequency of the atom in the system where it is at rest, and $n(\omega)$ is the index of refraction of the doppler frequency. At velocities greater than the speed of light, the atom emits frequencies determined by condition (2) during spontaneous transition from the normal to the excited state. Thus, radiation is directed inside of the Cerenkov cone where $\beta n(\omega)\cos\theta = 1$, and the energy of radiation and excitation is derived, due to the kinetic energy of the forward motion of the atom. During the spontaneous transition from the excited to the ground state, the atom radiates the usual doppler frequencies.
D.S.G.

N65-14337# Air Force Systems Command, Wright-Patterson, AFB, Ohio. Foreign Technology Div.
DESIGN OF MODELS, DIMENSIONS, AND SIMILARITY
L. I. Sedov 4 May 1964 23 p ref Transl. into ENGLISH from Priroda (Moscow), no. 7, 1953 p 13–21
(FTD-MT-63-311; AD-602577) OTS: $1.00

The validity of physical principles is independent of the units conventionally used to express the observable relationships. From this it follows that mathematical models for most physical principles can be formulated in the abstract or in dimensionless terms. Examples from hydrodynamics, the motion of a solid body through a liquid or gas, and the motion of gases propelled by an explosion, illustrate how mathematical models involving dimensionless parameters are constructed. In making practical applications of mathematical models, or in relating finite dimensions to variations of a dimensionless model, it is necessary that several functions by truly similar. The simulation of gravity by centrifugal motion is an example of an apparently invariable force being replaced in a mathematical model by a variable. E.K.R.

N65-14400# Army Frankford Arsenal, Philadelphia, Pa. Physics Research Lab.
ANALYSIS OF SHOCK ACCELERATION RECORDS
F. Reagan, Jr. Aug. 1964 21 p ref
(M65-4-1; AD-450280)

The object of this study was to determine the minimum number of specific constituent frequencies and the associated amplitudes in a given nonperiodic waveform in the measurement of shock and interpretation of shock records. It was decided to approximate the waveform with trigonometric terms, which suggested a Fourier Series approach. However, the minimum number of terms was desired. The approach used represents the waveform with a finite series of exponentials, the terms having complex exponents representing the "periodic" portion, and the real exponents representing the "decay." A technique was developed which determined the frequencies and associated decay constants giving the best fit to the record for a particular number of terms. The accuracy of the

technique depends primarily on: (1) the accuracy of the original data; (2) the interval chosen; and (3) the length of the record used. The method developed has some merit, but additional work is required to determine its usefulness. Author

N65-14412# Naval Research Lab., Washington, D.C. Optics Div.
EXPERIMENTAL OBSERVATIONS OF FORWARD SCATTERING OF LIGHT IN THE LOWER ATMOSPHERE
J. A. Curcio and L. F. Drummeter, Jr. 30 Sep. 1964 38 p refs (NRL-6152; AD-607487)

Experimental results are presented for the following measurements of the forward scattering of light by the atmospheric aerosol: (1) light scattered forward from a 50 000-W omnidirectional light source, when viewed from a point 45 km away below the horizon; (2) light scattered forward from a 10 000-W collimated carbon-arc light source having a 1/2° beamwidth, directed tangentially; (3) airborne observations of forward scattered light from a searchlight beam 1/2° wide; (4) ground-based comparison of direct-line-of-sight irradiance and small-angle forward-scattered-light irradiance; (5) signals as a function of distance measured with the help of a mobile omnidirectional light source; (6) ruby laser light transmitted at night over the horizon to a distance of 45 km when both receiver and projector were 6 ft above water and were pointed at one another with 0-degree elevation; and (7) an over-the-horizon link established on a continuous basis over a range of 45 km. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-13358 Queens U., Belfast (Northern Ireland).
CALCULATION OF SCATTERING CROSS SECTIONS USING THE FIRST AND SECOND BORN APPROXIMATION
In its Res. on Phys. of The Upper Atmosphere 30 Jun. 1964 p 21–30 refs (See N65-13351 04-34)

The second Born approximation is used to calculate the cross sections for the excitation of the 2p states of atomic hydrogen by proton, electron, and positron impact, allowance being made for the effect of virtual transitions involving the 1s, 2s, and $2p_0$, ± 1 intermediate states. Author

N65-13360 Queens U., Belfast (Northern Ireland).
PHOTO-IONIZATION CROSS-SECTION OF MOLECULAR HYDROGEN
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1964 p 38–40 refs (See N65-13351 04-34)

Calculations are being made using the dipole length formula, so that results depend mainly on the behavior of the wave functions at fairly large distances from the nuclei. In the final state the system consists of a hydrogen molecular ion in the $1p\sigma_g$ state and a free electron. The orbital of the free electron can be calculated by numerical integration using elliptical coordinates, but it is necessary to determine the phase shift in the continuum orbital. Attempts were made to determine this phase shift from the observed discrete energies of the excited states of the hydrogen molecule by using an adaptation of the method of quantum defect; about 20% uncertainty was found in the final results. D.S.G.

N65-13361 Queens U., Belfast (Northern Ireland).
SEMI-EMPIRICAL EFFECTIVE POTENTIALS FOR USE IN ATOMIC, MOLECULAR AND SOLID-STATE PROBLEMS
In its Res. on Phys. of The Upper Atmosphere 30 Jun. 1964 p 42–46 refs (See N65-13351 04-34)

Calculations on systems in which there are one or a few electrons outside closed shells are considerably simplified if the interaction, including exchange, between the outer electrons and the closed-shell electrons can be represented by means of an effective potential. A method for determining such an effective potential is under development. Improved modifications of earlier work on the polarization potential are presented. D.S.G.

N65-13362 Queens U., Belfast (Northern Ireland).
THREE ELECTRON SYSTEMS
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1964 p 47–51 refs (See N65-13351 04-34)

The ab initio calculations of the fine structure separation of the $1s^2np^2P$, n = 2, 3, and 4 states of the three-electron systems are made using wave functions of the open shell type. Satisfactory agreement with experiment is obtained only in the case of the highly ionized systems. Author

N65-13363 Queens U., Belfast (Northern Ireland).
LONG RANGE FORCES BETWEEN PAIRS OF ATOMS
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1964 p 52–53 (See N65-13351 04-34)

The coefficient of the loading term of the series representation of a long-range interaction may be written, apart from external factors, as $C = \sum_{m,n} \frac{f^a_m f^b_n}{E^a_m E^b_n (E^a_m + E^b_n)}$

where f is the electric dipole oscillator strength and E is the excitation energy. The difficulty in carrying out the summations over the excited states lies in the sum of excitation energies which prevents the two-atom problem from being reduced to a product of single-atom problems. This can be achieved using an alternative expression for C, which is presented. Author

N65-13525*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FINITE GEOMETRY CORRECTIONS TO GAMMA-RAY ANGULAR CORRELATION MEASUREMENTS
Jag J. Singh and Chris Gross (Coll. of William and Mary) Jan. 1965 41 p refs
(NASA-TN-D-2549) OTS: HC $2.00/MF $0.50

Large cylindrical sodium iodide crystals are used extensively in gamma-ray angular correlation measurements. The finite angular resolution of these crystals affects the observed distribution of the gamma radiation. The measured distribution function was corrected for finite geometry effects before the results were compared with the theory. The correction factors depend upon the geometry of the counters and the absorption properties of the counter material. For detectors with axial symmetry, the effects of finite solid angle are to reduce the anisotropy without changing the form of the distribution function.

These reduction factors were calculated for gamma-ray energies ranging from 100 keV up to 15 MeV. The cylindrical sodium iodide crystals considered include all regular sizes from 1.0 in. by 0.5 in. up to 5.0 in. by 5.0 in., and the distance between the target and the sodium iodide crystal varied from 5.0 cm up to 35 cm. The results are tabulated in the form of attenuation factors representing the fractional decreases in the coefficients of the true angular distribution function. When the entire area under the gamma-ray pulse is considered at each angle, these tables are accurate throughout the range of energies of gamma rays considered. Author

N65-13542*# Consultants and Designers, Inc., Arlington, Va.
MOSSBAUER EFFECT AND IONIC CHARACTER OF IRON ATOMS IN THE ORGUEIL AND COLD BOKKEVELD METEORITES [EFFET MOSSBAUER ET CARACTERE IONIQUE DES ATOMES DE FER DANS LES METEORITES ORGUEIL ET COLD BOKKEVELD]
André Gérard and Michel Delmelle 25 Nov. 1964 6 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 259, 1964 p 1756–1759
(Contract NAS5-3760)
(NASA-TT-F-9600; ST-CC-10250) OTS: HC $1.00/MF $0.50

The study by the Mössbauer effect of the Orgueil chondrite ascertained the presence of Fe_3O_4 and of Fe^{3+} ions included in a silicate. The Cold Bokkeveld chondrite, to the contrary, does not include any magnetic compound, but does include Fe^{2+} and Fe^{3+} ions. Author

N65-13843# Battelle Memorial Inst., Columbus, Ohio.
VAPOR DEPOSITION OF FILMS OF NEODYMIUM COMPOUNDS
Thomas Gabor, John M. Blocher, Jr., and Robert C. Bowman 1 Dec. 1964 22 p refs
(Contract W-7405-ENG-92)
(BMI-1706) OTS: $0.50

The formation of dense, adherent films of neodymium compounds was explored as a model for the deposition of promethium-compound films for subsequent use in a Pm^{147} atomic battery. Adherent, dense, and transparent films of NdF_3 were deposited on silicon and aluminum by condensation of NdF_3 vapor. The possibility of chemical vapor transport was also investigated. However, no conditions were found for the transport of oxide within the temperature limitations of the substrate. A method was developed to increase adhesion of Nd_2O_3 films to silicon by the use of butadiene–styrene copolymer latex binder, and also by the use of a highly cross-linked carbon. Author

N65-13854# Kyoto U. (Japan). Research Inst. for Fundamental Physics
A MONTE CARLO ANALYSIS OF ELECTROMAGNETIC CASCADE SHOWERS
Atsuko Adachi, Yoichi Fujimoto, Naofumi Ogita, Shuji Takagi, and Akira Ueda Oct. 1964 93 p refs
(RIFP-40)

The characteristic features of electromagnetic cascade showers, initiated by high-energy γ-rays, are examined in detail using the Monte Carlo method. A three-dimensional approach is used and a device that takes into account the deviation of shower particles from the shower axes is introduced. It is shown that the Nishimura–Kamata function evaluated for infinite primary energy, may not be applicable under all conditions. Other distribution functions are also given, and their variances and their coefficients of variation are presented, along with a discussion of their interrelations. The results discussed are used to obtain a useful approach to the estimation of the energies of primary γ-rays and their production heights. Author

N65-14075# Washington U., St. Louis, Mo.
PULSED MAGNETIC RESONANCE STUDIES AT LOW TEMPERATURES
Richard E. Norberg 30 Jun. 1964 7 p refs
(Contract DA-ARO(D)-31-124-G65)
(AROD-2791-5; AD-608392)

The method of pulsed nuclear magnetic resonance was applied to measurements of nuclear spin susceptibility, relaxation times, and atomic self-diffusion in liquid and gaseous He^3 and in solid and liquid xenon. A search was initiated for a predicted dispersion in the excitation spectrum of helium II. Author

N65-14213# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF CIRCULAR ACCELERATORS
A. A. Kolomenskiy and A. N. Lebdev 21 Sep. 1964 417 p refs Transl. into ENGLISH of the book "Teoriya Tsiklicheskikh Uskoriteley" Moscow, Gos. Izd. Fiz.-Mat. Lit., 1962 p 1–352
(FTD-MT-64-94; AD-608081)

This book contains a systematic account of the general theory of contemporary circular accelerators and a description of the peculiarities of various types of installations. Both principal theoretical questions and the most essential applied problems and methods of calculating parameters and tolerances are treated. Special attention is given to work completed during the last few years and to problems of obtaining maximums of energy and intensity of accelerated particles. Strong-focusing accelerators, radiation effects, the problem of the accumulation of particles, etc., are considered in detail. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-13349# Elcon Lab., Inc., Watertown, Mass.
INTERACTION OF ELECTROMAGNETIC WAVES AND CLASSICAL PLASMAS Monthly Report No. 1
12 Jul. 1963 4 p
(Contract AF 33(657)-11671)
(R-7-63-4; AD-439846)

An experiment for testing the cross-beam, cross-modulation plasma diagnostic technique is being designed. The expected signal and noise for a weak plasma in argon were investigated. The calculations show that for a 30-mW pumping beam, the cross-modulation signal on the probing beam will be about 45 dB below the probing beam power. The thermal noise from the plasma will be very small compared with the signal (approximately another 60 dB lower) so that the principal consideration is the sensitivity of the detector. A plasma bottle has been constructed and successfully operated. P.V.E.

N65-13372# Los Alamos Scientific Lab., N. Mex.
LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM Semiannual Status Report, Period Ending Oct. 20, 1964
11 Dec. 1964 141 p refs
(Contract W-7405-ENG-36)
(LA-3202-MS) OTS: $4.00

The following controlled thermonuclear studies were performed: pulsed systems for sudden plasma creation, magnetic coils for explosive after-compression, the toroidal caulked cusp device and its design calculations, field penetration, hydrodynamic plasma guns, high-density plasma focus, Scylla IV low-pressure regime, and a variety of supporting investigations. G.G.

N65-13400# California U., Livermore. Lawrence Radiation Lab.
VISIT OF U.S. CONTROLLED-FUSION RESEARCH TEAM TO THE U.S.S.R., FEBRUARY 9–23, 1964
Chester M. Van Atta, ed. [1964] 202 p refs
(Contract W-7405-ENG-48)
(TID-21189) OTS: $6.00

This summary points out the high standard of Russian theoretical work in the major fields of nonlinear theory, i.e., quasi-linear, wave–wave interactions, collisionless shocks, and turbulence. Activity was also observed in calculations of plasma waves, radiation, and microinstabilities. The studies of drift instabilities of an inhomogeneous plasma have been extended to consider collisional effects, finite β-effects, high frequency modes, etc. Little work was done in the direction of theoretical confinement geometries and attributed to an apparent lack of high-speed computer facilities. The report includes a number of calculations pertaining to the above-mentioned subjects. G.G.

N65-13443# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLOW OF ELECTRO-CONDUCTIVE GAS WITH CONSTANT SPEED IN THE DUCT OF A MAGNETOHYDRODYNAMIC GENERATOR
A. V. Gubarec, V. I. Kovbasyuk et al 18 May 1964 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 3, 1963 p 3–8
(FTD-MT-64-22; AD-606741)

In one-dimensional form an analysis is conducted of conditions of flow in the duct of a magnetohydrodynamic (MHD) generator, at constant speed, taking into account factors influencing change in electrical efficiency and in the induction of the magnetic field along its length. Special attention is given to the selection of parameters by which various types of generators can be compared, and to the conditions of operation of an MHD generator that influences its internal efficiency. Author

N65-13444# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTERACTION OF BEAMS OF CHARGED PARTICLES WITH PLASMA
Ya. B. Faynberg 2 Mar. 1964 41 p refs Transl. into ENGLISH from Fiz. Plazmy i Probl. Upravlyayemogo Termoyader. Sintez (Kiev), p 88–117
(FTD-MT-64-26; AD-605901)

The interactions of charged particle beams and oscillators with plasmas are divided into three basic groups: (1) the instabilities caused by the Vavilov–Cerenkov effect during the interaction of electronic and ion beams with a plasma in a magnetic field; (2) the instabilities caused by an anomalous Doppler effect; and (3) the instabilities caused by the normal Doppler effect. The main characteristics caused by the above-mentioned effects are calculated and presented in tables. The instabilities of confined plasmas and the essential significance of nonlinear processes in their calculations are discussed. G.G.

N65-13503# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
DETERMINATION OF THE TEMPERATURE PROFILE OF AN OPTICALLY THICK CYLINDRICALLY SYMMETRIC LABORATORY PLASMA
Paul W. Elder (M.S. Thesis) May 1964 24 p refs
(GSP/PHYS/64-3; AD-603685)

The temperature profile of a self-absorbing, radially symmetric, cylindrical laboratory plasma is experimentally determined using a spectroradiometric technique. The technique involves the measurement of the ratio of the spectral radiant emittance of the plasma gas to its spectral absorptivity that, according to Kirchhoff's law, is equal to the spectral radiant emittance of a blackbody at the same temperature and wavelength. The method does not depend on knowledge of the transition probabilities or number densities of the gas under study, or even its composition, and it is valid whenever departures from local thermal equilibrium in the plasma are small. Author

N65-13790# Columbia U., N.Y. Columbia Radiation Lab.
THE OPTICAL MASER APPLIED TO BRILLOUIN SCATTERING SPECTROSCOPY Progress Report, 1 Oct. 1963–31 Mar. 1964
R. Novick Apr. 1964 3 p refs
(Contract DA-ARO(D)-31-124-0380)
(PR-3; AD-605736)

Measurements of linewidth of Rayleigh scattering due to diffusion were completed. Small discrepancies between theory and experimental data were traced to Doppler shift effects produced by thermal convection in the solvent, and were subsequently eliminated. In an auxiliary experiment, this same Doppler effect was studied with the solvent current controlled mechanically. Results indicate that this effect can be used as a technique in fluid flow measurements. A Hg^{+} laser was constructed and operated in a pulsed mode. Another structure with a 2.5-mm-bore discharge tube was completed. Continuous-wave laser action is being attempted with this design. R.L.K.

N65-13824*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GRAPHICAL RESULTS FOR LARGE-AMPLITUDE UNSTEADY ONE-DIMENSIONAL WAVES IN MAGNETIZED COLLISION-FREE PLASMAS WITH DISCRETE STRUCTURE
Wm. Prichard Jones and Vernon J. Rossow Washington, NASA, Jan. 1965 86 p refs
(NASA-TN-D-2536) OTS: HC $3.00/MF $0.75

Structure of the compressed layer of gas behind one-dimensional time-dependent large-amplitude waves moving across a collisionless fully ionized magnetic plasma is studied by means of electronic computer codes developed by Auer, Hurwitz, and Kilb. Data from these codes are processed by an automatic digital-to-analog plotter and presented graphically in several formats that make it possible to observe special characteristics of the development of collisionless shock waves.

Cases considered in the first sequence of solutions illustrate the variation of the structure of the flow field with Alfven Mach number of the shock front. Changes brought about in these flow fields when the driving and ambient magnetic fields are assumed to be of opposite sign are then studied. Waveforms that result when two identical collisionless shock waves collide are presented for two special situations. The effect of the mass ratio of the two charged species and the temperature of the ambient plasma on the structure of the magnetic field in the flow field is also considered. Author

N65-13867*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HYDROMAGNETIC STABILITY OF STELLAR ATMOSPHERES
Satya P. Talwar Washington, NASA, Jan. 1965 18 p refs (NASA-TN-D-2218) OTS: HC $1.00/MF $0.50

The effect of a horizontal magnetic field on the equilibrium of an inviscid, perfectly conducting, stratified plasma under uniform rotation is investigated. The equations of the problem are established when both the density and magnetic field vary with the vertical distance. Then special density distributions are studied, including a layer of stratified plasma and a configuration of incompressible fluid topped by a stratified compressible fluid. Criteria of instability are derived. Author

N65-13898 Joint Publications Research Service, Washington, D.C.
THE RADIATION REACTION FOR A CHARGE MOVING IN A PERIODICALLY INHOMOGENEOUS MEDIUM
V. V. Tamoykin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 56–70 refs (See N65-13892 04-07) OTS: $6.00

The radiation of electromagnetic waves for a charged particle moving in a medium with periodically varying properties is considered. It is assumed that in addition to the translational motion of the charge, the particle oscillates with a frequency Ω. Even in a weakly inhomogeneous medium, it is necessary in separate cases, to take into account the resonance between the oscillations of the oscillator and the field of the transition radiation which may lead to an oscillation buildup. The expressions for the energy of the radiated electromagnetic waves are obtained for a medium with large-scale and small-scale inhomogeneities. Author

N65-13900 Joint Publications Research Service, Washington, D.C.
THE PROPAGATION OF ELECTROMAGNETIC WAVES IN NONLINEAR MEDIA
L. A. Pospelov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 77–84 refs (See N65-13892 04-07) OTS: $6.00

The calculation of the dissipation and the nonlinear dependence of the induction on the field intensity for an arbitrary anisotropic medium is given. For the case of small dispersion and slight nonlinearity, the initial system of Maxwell's equations reduces to one equation; the investigation of the exact solution provides a possibility of explaining the role of the dissipation (finite medium conductivity) in the distortion of the wave shape and in the formation of a discontinuity (shock wave). Author

N65-13901 Joint Publications Research Service, Washington, D.C.
THE SCATTERING OF ELECTROMAGNETIC WAVES IN A NON-EQUILIBRIUM PLASMA
N. V. Sholokhov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 85–96 refs (See N65-13892 04-07) OTS: $6.00

The effect of transverse waves in a plasma on the scattering of electromagnetic waves by a plasma-beam system is investigated. The investigation is limited to the calculation of the coulomb interaction of the particles (longitudinal waves) since the increase in fluctuations is associated with the instability of the longitudinal waves in the plasma. The scattering of electromagnetic waves by a plasma is determined by the correlation of the electron density fluctuations. The spectral correlation function in a nonequilibrium collisionless plasma is computed and the electron drift in a plasma is studied to determine the effects associated with transverse waves. P.V.E.

N65-13917 Joint Publications Research Service, Washington, D.C.
NONLINEAR PERTURBATION OF PLASMA WAVES
A. G. Litvak *In its* VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 250–253 refs (See N65-13892 04-07) OTS: $6.00

Strong plasma waves may be generated by pairs of electromagnetic waves whose frequencies ω_1, ω_2, and wave vectors k_1, k_2, satisfy the relationships

$$\Omega = \omega_1 + \omega_2$$
$$k = k_1 + k_2 \qquad (1)$$

where Ω and k are the frequency and wave vector of the plasma wave. A similar effect is possible only in magnetoactive plasma, since in isotropic plasma electromagnetic waves of frequencies ω_1, $\omega_2 > \Omega$ are not able to propagate. For waves satisfying the relationships

$$\Omega = \omega_1 - \omega_2$$
$$k = k_1 - k_2 \qquad (2)$$

instability is absent. This article shows that, for the propagation of a pair of strong electromagnetic waves in an isotropic plasma, a plasma wave is formed whose wave vector and frequency satisfy the equalities (2). Author

N65-13942 Oxford U. (Gt. Brit.)
FREE MOLECULE LANGMUIR PROBES IN A FLOWING PLASMA
C. L. Brundin and L. Talbot (Calif. U., Berkeley) *In* IEEE Proc. of the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facilities [1964] 15 p refs (See N65-13922 04-14)

A discussion is presented of the theories underlying the operation and interpretation of several different free molecular Langmuir probe configurations. Emphasis is directed toward the use of such probes for the measurement of ion density and electron temperature in flowing plasmas. Experimental results are presented which support the theoretical predictions. Some recommendations are given concerning the probe geometries most suitable for either ion density or electron temperature determinations. Author

N65-13957# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
THE VIRIAL THEOREM FOR SELF-GRAVITATING AND RADIATING GASEOUS SYSTEMS AND ITS APPLICATIONS
Mathematical Note No. 360

S. P. S. Anand Aug. 1964 43 p refs
(DI-82-0366; AD-607352)

Using the radiation stress tensor defined by Ledoux and Walraven, the virial tensor equations for a self-gravitating gaseous system with interaction between radiation and matter were obtained by defining a potential tensor of gravitational potential. Only the scalar form of this equation is used, in this paper, for the stability and oscillations of such a system in the presence of radiation interactions. The basic virial tensor equations for radiating systems are formulated, and the modified form due to magnetic fields and rotation is given. The virial theorem for equilibrium configurations is given and applied. The radial oscillations, the stability of the radiating systems, and the rate of the dissipation of kinetic energy are discussed.
D.E.W

N65-14018 Michigan U., Ann Arbor. Electron Physics Lab.
THE SOLUTION OF NONLINEAR BOUNDARY-VALUE TRANSPORT PROBLEMS IN ELECTRON AND PLASMA DEVICES Technical Report No. 72
C. L. Dolph and R. J. Lomax Griffiss AFB, N.Y., RADC, Oct. 1964 74 p refs
(Contract AF 30(602)-2834)
(RADC-TDR-64-393; AD-608618)

A method of solution of the nonlinear Landau–Vlasov equation, which occurs in charged particle transport phenomena, is described. The method is similar in concept to the spherical harmonics method of neutron transport theory since the particle distribution function is expanded in orthogonal functions of velocity to obtain an infinite set of partial differential equations. The nonlinearity arises when the particle interactions are taken into account in the force term of the Landau–Vlasov equation. The latter is introduced into the equation iteratively, and a numerical integration routine is described to integrate the set of equations resulting from a finite (nth order) truncation of the expansion. The convergence of the finite-difference equations and the convergence of the finite-difference solution to the solution of the differential equations is proved for the linear case in which the force is assumed to be known. Computational evidence of the convergence in the nonlinear case is provided.
Author

N65-14065 Harry Diamond Labs., Washington, D.C.
A SPECTROSCOPIC METHOD OF MEASURING ELECTRON DENSITY IN A SHOCK WAVE INDUCED ARGON-HYDROGEN PLASMA
Harry A. Gieske 5 Aug. 1964 45 p refs
(HDL-TR-1238; AD-451180)

A technique for the time-resolved measurement of electron density in a shock-heated argon–hydrogen mixture utilizing the Stark broadening of the hydrogen beta line (4861 Å) is described. Descriptions of experimental apparatus, procedures, and preliminary results are given for measurements made at the stagnation point of a blunt body and in the region behind the incident shock for Mach numbers between 8.8 and 11.6. Preliminary results show that time-resolved electron density measurements can be made using this technique, but that the calibration technique must be improved.
Author

N65-14074# Lightning and Transients Research Inst., Minneapolis, Minn.
LASER TYPE ULTRA-VIOLET RADIATION FEASIBILITY FOR LIGHTNING AND ATMOSPHERIC PROPAGATION STUDIES, PART II Final Report
J. R. Stahmann Oct. 1964 25 p refs
(Contract AF 19(604)-7984)
(L&T-417; AFCRL-64-859, Pt. II; AD-609217)

Laboratory experiments were limited to the use of a 14-kW carbon arc as a source in the far ultraviolet. No long spark diversion similar to that found with a jet plasma (10^7 to 10^8 ions/cc) was observed with the carbon arc source. Methods of selective ionization to distribute the ions over the beam with just the density required for the conductivity of a jet plasma include possible rocket distribution of combustible particles to be ignited by a conventional laser beam for distances of several miles.
Author

N65-14101# Paris U., Orsay (France). Laboratoire de Physique des Plasmas
ON THE COLLECTIVE DESCRIPTION OF CLASSICAL PLASMAS Technical Note No. 1
G. Kalman Apr. 1964 107 p refs
(Contract AF 61(052)-613)
(ARL-64-140; AD-602419)

Collective coordinates are considered as a linear transformation of deviations from the unperturbed orbit. In general they are admixtures of particle coordinates and of particle momenta. On this basis a reformulation and generalization of the Bohm–Pines theory and a classical equivalent of Brout's method are introduced. The correspondence of the two treatments is demonstrated. The method developed is employed to establish a collective description of magnetostatic interaction. A Hamiltonian describing magnetic interaction in terms of particle variables is derived. This serves as a starting point. The Fourier transform of the momentum density appears as a collective coordinate. Subsequent canonical transformations lead to a collective fluidlike description, to an extended Hamiltonian with coupling, and to dressed uncoupled collective variables. A new collective mode with two transverse polarizations emerges; it exhibits an unstable behavior and prevails in the case of anisotropic velocity distribution only. In general it is coupled to the plasma oscillation mode. Finally the dielectric description of a system with anisotropic temperature-tensor is presented.
Author

N65-14137# Wisconsin U., Madison. Mathematics Research Center
AN EXACT ANALYSIS OF LAMINAR MAGNETOHYDRODYNAMIC FLOW IN THE ENTRANCE REGION OF A FLAT DUCT
R. Manohar Sep. 1964 25 p refs
(Contract DA-11-022-ORD-2059)
(MRC-509; AD-608860)

A numerical method for obtaining solutions of laminar boundary-layer equations for incompressible fluids, due to Hartree, was modified to obtain solutions of the problem of laminar flow of a conducting fluid with constant properties in the entrance region of a semi-infinite flat duct with a transverse magnetic field. The nonlinear equations governing the flow in the entrance region are solved numerically for various values of Hartmann numbers, and the corresponding velocity profiles, pressure distribution, and inlet length are obtained.
Author

N65-14142# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
NONEQUILIBRIUM ELECTRIC CONDUCTIVITY OF WET AND DRY POTASSIUM VAPOR
Alexander W. Rowe and Jack L. Kerrebrock Wright-Patterson AFB, Ohio, AF Propulsion Lab., 2 Nov. 1964 85 p refs
(Contract AF 33(615)-1083)
(APL-TDR-64-106; AD-608831)

The nonequilibrium electric conductivity of two-phase potassium vapor was studied both theoretically and experimentally. This study is important in connection with the design of Rankine-cycle alkali-metal magnetohydrodynamic (MHD) generators. The theoretical work indicates that small condensation droplets (mean radius less than 50 Å) will detrimentally affect the achievement of elevated electron temperatures by Joule heating, and will also reduce the vapor ionization associated with this temperature. These effects, which arise from large electron-drop collision energy losses, are negligible when the mean droplet radius is greater than 200 Å. A high-temperature (maximum temperature = 2000° K) closed-loop facility was constructed for the study of nonequilibrium ionization in wet and dry potassium vapor. Preliminary experimental results on the electric conductivity of potassium in a subsonic test section are given. The results suggest that the condensation existed as a myriad of nucleation-sized (mean radius ~10 Å) droplets that reduced the nonequilibrium conductivity appreciably below that of the dry vapor. Author

N65-14145# Bendix Corp., Southfield, Mich. Research Labs. Div.
DETERMINATION OF CHEMICAL SPECIES PREVALENT IN A PLASMA JET, PART II Technical Documentary Report, 1 Mar. 1963–29 Feb. 1964
G. J. O'Halloran and L. W. Walker Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1964 36 p refs
(Contract AF 33(657)-11018)
(ASD-TDR-62-644; Pt. II; AD-608867)

A modified time-of-flight mass spectrometer, equipped with a specially designed inlet system, was used to conduct investigations of an arc plasma jet exhausting into the atmosphere to provide a better understanding of the chemical and physical processes occurring in this type of extreme thermal environment. Various aspects of the interaction between the inlet probe and an atmospheric pressure plasma sample were clarified. Probable velocity distribution perturbations were observed, and changes in sample concentrations as a result of species separations occurring during the supersonic expansion were observed and correlated. Additional species identifications and measurements were performed. Neutral $^{44}CO_2$ was detected, and its concentration in the plasma sample was determined. Detection sensitivities for neutral species present in the input gas-plasma flow down to the 0.01 percent level were demonstrated. Detailed information describing the differences between those mechanisms governing the entrainment, mixing, and ionization of species from the atmosphere and those governing the distribution and ionization of species injected directly into the arc chamber was derived. The repeatability of the complete system was determined. Author

N65-14154 Maryland U., College Park. Atmospheric and Space Physics Center
THE DEVELOPMENT OF A PROBE SYSTEM FOR THE MEASUREMENT OF PLASMAS IN THE UPPER ATMOSPHERE Final Report, 1 Apr. 1959–30 Sep. 1962
Richard T. Bettinger Sep. 1963 60 p refs
(Contract AF 19(604)-5575)
(AFCRL-64-102; AD-609015)

The problem of the measurement of ionospheric parameters, particularly under unusual or extreme conditions, was approached by means of a unique in situ probe system consisting of a thermal equalization probe to measure the potential of the carrier platform, a pulse probe to measure the electron concentration and energy distribution, and a Langmuir probe to measure positive ion temperatures. In addition, the requisite support systems including telemetry and flight vehicles were developed. The entire system was proven by flight tests. Author

N65-14189# Columbia U., New York, N.Y. Plasma Lab.
STRONG IONIZING SHOCK WAVES
Robert A. Gross Oct. 1964 69 p refs
(Contract AF 49(638)-1254)
(Rept.-15)

Electromagnetically driven shock waves in hydrogen are theoretically studied for speeds up to relativistic conditions. In the progression from weak to relativistic shock speeds, various physical phenomena affect the shock wave. Dissociation, ionization, and the presence of an upstream electric field cause several important effects for slow (sub-Alfvénic speed) normal ionizing shock waves. Switch-on shock behavior is extended to slow ionizing waves. The effect of radiation is investigated for both the optically thick and thin cases. Relativistic shock jump equations are solved for wave speeds approaching the speed of light. Thermonuclear shock solutions are examined. The shock jump equations and the shock tube problem are solved numerically. Wave stability is reviewed. Some experimental results are discussed. Author

N65-14216# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PLASMA JET
J. Lominadze 21 Oct. 1964 13 p Transl. into ENGLISH from Metaniereba Da Tekhn. (USSR), no. 3, 1960 p 14–18
(FTD-TT-64-35/1+2+3+4; AD-607903)

Present systems capable of using high-temperature, high-velocity gas streams are severely limited. Such streams produced in shock tubes with the aid of shock waves can raise the temperature of air to 4000° C. Although the upper limit of temperature for chemical reaction is about 6000° C, the electron temperature of plasma is 11 000° C, and the plasma generator produces a plasma jet-impulse of relatively long duration with temperatures ranging from 8000° to 17 000° C. The plasma generator is described, and its application to high-temperature wind tunnels in the study of plasmas created by shock waves attending bodies moving at supersonic speeds is discussed. E.E.B.

N65-14264*# Northwestern U., Evanston, Ill. Gas Dynamics Lab.
PHYSICO-CHEMICAL DIAGNOSTICS OF PLASMAS. PROCEEDINGS OF THE FIFTH BIENNIAL GAS DYNAMICS SYMPOSIUM
Thomas P. Anderson, Robert W. Springer, and Richard C. Warder, Jr., ed. Evanston Ill., Northwestern U. Press [1963] 42 p refs Symp. Held at Evanston, Ill., 14–16 Aug. 1963; sponsored by ARPA, ONR, AF, Army, AIAA et al
(NASA Order R-96)
(NASA-CR-60081) Available from Northwestern U. Press: $15.00

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N65-14312# Stanford U., Calif. Microwave Lab.
SPACE-CHARGE WAVES IN AN ACCELERATED PARALLEL-FLOW ELECTRON BEAM IN A CONSTANT MAGNETIC FIELD Interim Report
Bas Hoeks Griffiss AFB, N.Y., RADC, Oct. 1964 61 p refs
(Contract AF 30(602)-2575)
(ML-1205; RADC-TDR-64-404; AD-608988)

The small-perturbed electron motions are considered in an accelerated (space-charge limited) circular-cylindrical electron beam in a parallel-flow Pierce-type electron gun, and to establish whether the noise fluctuations coming off the cathode will grow or decay as a function of distance, and what effect an applied dc magnetic field parallel to the electron flow direction has upon these fluctuations. It was found that, for increasing distances from the cathode, the magnitude of the perturbed radial electron displacement will increase indefinitely without the applied dc magnetic field and it will reach an asymptotic value beyond a certain distance from the cathode when this field is present. The stronger the applied field is, the shorter this distance will be. The transverse, as well as the quasi-static part of the axial electric field intensities, however, will decay in both cases. The nonquasi-static part (i.e., in the case of very-high-signal frequencies) of the axial electric field intensity behaves similar to the radial displacement. Author

N65-14341# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRODYNAMIC ACCELERATION OF PLASMOIDS
I. T. Guzhovskiy, A. F. Krivonos, and B. G. Safronov 2 Mar. 1964 9 p refs Transl. into ENGLISH from Fiz. Plazmy i Probl. Upravlyaemykh Termoyader. Sintex. Ukr. Akad. Nauk (Kiev) p 219–223
(FTD-MT-64-28; AD-605605) OTS: $1.00

An experimental installation is described which uses a conical plasma source for obtaining plasmoids propagating in a vacuum with speeds greater than 1×10^7 cm/sec. Although the main part of the force ejecting the plasma from the source is connected with the gas kinetic pressure and only a smaller part with the electrodynamic pressure due to the conical configuration of the discharge current, an increase of the electromagnetic pressure accelerating the plasma is obtained by replacing the cylindrical reverse conductor of the source with a four-turn spiral wound on the external conical surface of the source. Through the use of the time-increasing magnetic field created by the reverse spiral conductor, plasmoids with speeds of 3×10^7 were obtained. D.S.G.

N65-14360# Princeton U., N.J. Plasma Physics Lab.
ON RADIATION PROCESSES IN PLASMAS
T. Birmingham, J. Dawson, and C. Oberman May 1964 64 p refs
(Contract AT(30-1)-1238)
(MATT-266)

The problem of arbitrary test current sources embedded in an infinite spatially homogeneous Vlasov plasma is considered. By computing the rate at which the test sources do work on the plasma, the energy emission into transverse and longitudinal waves is obtained. A variety of radiation problems can be handled by appropriate choice of the current sources. Use of the time-varying dipole moment, due to encounters between shielded electrons and ions, leads to expressions for the bremsstrahlung spectra. If the currents are produced by the interaction of waves with density fluctuations, the scattering and coupling of waves is obtained. By equating the rate of emission of longitudinal or transverse waves to their rate of absorption, expressions are obtained for the steady-state energy densities of such waves. Author

N65-14362# Princeton U., N.J. Plasma Physics Lab.
TEMPERATURE AND POWER MEASUREMENTS IN A PLASMA HEATED BY ABSORPTION OF ION CYCLOTRON WAVES
W. M. Hooke, M. A. Rothman, J. Sinnis, and J. Adam Oct. 1964 38 p refs
(Contract AT(30-1)-1238)
(MATT-304)

A plasma in a magnetic mirror field is heated by means of an induction coil which generates plasma waves at a frequency near the gyrofrequency of the ions. Several hundred kilowatts of power are transmitted to the plasma. Ion energies in the neighborhood of 1 keV are observed in a small volume within

the plasma. These energies are believed to be associated with ions trapped within a small magnetic mirror region following their acceleration by ion cyclotron damping of the waves. In a deuterium plasma, production of neutrons is observed in association with these trapped ions. Ion energies of 200 to 300 eV are found throughout the total 10-liter plasma volume. The electron temperature is approximately 10 eV. Energy is lost from the plasma in times ranging from 30 to 50μsec. Author

N65-14377# Minnesota U., Minneapolis.
A STUDY OF THE TRANSIENT BEHAVIOR OF PLASMAS Final Report, Apr. 1962 – Apr. 1964
Richard W. Carlson and Hendrik J. Oskam Wright-Patterson AFB, Ohio, AF Avionics Lab., Oct. 1964 96 p
(Contract AF 33(657)-8685)
(AL-TDR-64-248; AD-607941) OTS: $3.00

This report describes results obtained during studies of the dynamic properties of a plasma-boundary sheath. The main effort was directed toward the calculation and measurement of the capacitance of a plasma sheath. The calculations predicted that the capacitance value of a plasma sheath surrounding a cylindrical probe depends only weakly on the ratio of the probe radius and sheath radius. Measurements confirmed this prediction and, moreover, yielded values in agreement with theory. The method of calculating the probe-sheath capacitance is compared with those reported by other investigators. Author

N65-14397# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON MAGNETOHYDRODYNAMIC EQUATIONS
R. V. Polovin and K. P. Cherkasov 13 Mar. 1964 28 p refs Transl. into ENGLISH from Fiz. Plazmy i Probl. Upravlyaemykh Termoyader. Sintez, Ukr. Akad. Nauk (Kiev), p 196–217
(FTD-MT-64-27; AD-605600) OTS: $2.00

The following equations dealing with magnetohydrodynamics are developed and discussed: (1) equations of motion for plasmas consisting of N-type charged or neutral particles; (2) Ohm's law to zero approximations—magnetohydrodynamic description of plasma in a limiting case with all the magnitudes slowly changing in space and time; (3) Ohm's law to first approximations; (4) equation of motion for two-component plasmas—magnetohydrodynamic equations applicable to low- and high-frequency processes; (5) estimation of the magnitude of various components of the equation of motion and Ohm's law; and (6) estimations involving stationary flow around a motionless body. P.V.E.

N65-14431# Princeton U., N.J. Plasma-Physics Lab.
FOURIER ANALYZER FOR SPACE HARMONICS
K. Bol and K. Prelec Sep. 1964 5 p refs
(Contract AT(30-1)-1238)
(MATT-303)

The theory of operation of a Fourier analyzer with a finite number of inputs is briefly discussed, and a circuit for obtaining time-dependent Fourier amplitudes of spatially extended disturbances is described. P.V.E.

N65-14432# Princeton U., N.J. Plasma Physics Lab.
COOLING SYSTEM FOR MODEL C STELLARATOR
Robert S. Christie Dec. 1964 25 p refs
(Contract AT(30-1)-1238)
(MATT-315)

The cooling of the C stellarator confining field coils requires a deionized water system of large volume, of consistently high specific resistance, and one which operates well when subjected to widely fluctuating load changes. Outlined are some of the problems that are considered in the design of the system. The system is described in detail, as well as the control used. Some operating problems are discussed. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-13369# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
INJECTED ELECTRON-HOLE PLASMA PROPAGATION VELOCITY AND LIFETIME MEASUREMENTS IN P-TYPE INDIUM ANTIMONIDE
Michael F. Berg Dec. 1963 14 p ref
(DI-82-0323)

A finite time is required to complete the injection of an electron-hole plasma throughout the length of a sample of InSb. Upon application of an electric field across the sample ends, a cloud of electron-hole plasma forms at the negative contact and progresses down the sample length past two pairs of biased double probes spaced a known distance apart. As the front passes a probe pair, it produces a decrease in resistance between the pair. This passage is observed as a pulse on a high-speed oscilloscope. The measured velocity plotted as a function of applied electric field strength has an asymptotic upper limit of $\sim 6 \times 10^6$cm/sec. The velocity diminishes exponentially with decreasing electric field asymptotically to the field strength at which injection begins. The lifetime of this plasma, as measured by a double pulse technique, is ~ 1μsec through a density range of 1×10^{12} to 2.5×10^{13} carriers/cm^3. Author

N65-13394# Hewlett-Packard Co., Palo Alto, Calif.
ADVANCED FUNCTIONAL ELECTRONIC BLOCK DEVELOPMENT Interim Engineering Report, 1 Mar.–3 May 1964
[1964] 95 p refs
(Contract AF 33(657)-9772)
(IER-7; AD-603471) OTS: $4.00

Rigorous calculations were made of the electron lifetimes in zinc-doped GaAs and of the division of holes between the valence band and zinc acceptor states in zinc-diffused GaAs diodes. The results allow a calculation of the absolute magnitude of the electron diffusion current which agrees closely with experimental values throughout the temperature range from 77° to 300° K. The agreement requires the assumption that the bandgap in the p-region is shrunk by 0.025 eV. An analysis of the activation energy of the integrated intensity of the el emission also leads to the conclusion that the bandgap is shrunk by 0.025 eV. The bandwidth of the edge electroluminescence as a function of temperature is consistent with the assumption that at low temperatures a considerable part of the radiative recombinations involves holes in an acceptor band about 0.017 eV wide. The quantum efficiency of freshly etched diodes is found to decrease to a limiting value with time during the passage of forward current. Author

N65-13435# Brown U., Providence, R.I. Metals Research Lab.
ULTRASONIC METHODS IN THE STUDY OF DEFORMATION IN SINGLE CRYSTALS Technical Documentary Report, Jan. 1–Dec. 31, 1963
Bruce Chick, Akira Hikata, George Anderson, Charles Elbaum, and Rohn Truell Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1964 56 p refs
(Contract AF 33(657)-8324)
(ML-TDR-64-34; AD-606759)

The physical changes that occur in aluminum and in certain ionic crystals during and after deformation are studied. The contribution of dislocations to the anharmonic behavior of solids was found. This effect was explained in terms of dislocation loop characteristics, in the presence of an external static stress combined with an ultrasonic stress. Experiments on this effect were carried out as a function of static stress, dislocation loop length, crystallographic orientation, plastic deformation, and ultrasonic stress amplitude. Experiments were also carried out on the relation between changes of electrical conductivity and ultrasonic attenuation in alkali halides. The effects of plastic deformation and of temperature on this relation were studied. Preliminary experiments were conducted on the temperature dependence of the magnitude and sign of the surface charge developed in alkali halides. Additional experiments were carried out on the recovery of ultrasonic attenuation following plastic deformation and as a function of plastic strain. Author

N65-13504# Melpar, Inc., Falls Church, Va.
THIN-FILM MONOTRONICS Quarterly Report, 12 Jun.–12 Sep. 1964
Richard C. Smith [1964] 109 p refs
(Contract NOw-64-0568-d)
(QR-2; AD-607297) OTS: $4.00

Advances are reported in developing temperature-stable dielectric films using the dysprosium oxide system, in developing field-effect sensitive materials using tellurium and gadolinium telluride. Useful thin-film diodes were also realized. The gathering of data for use in the design of high-temperature, radiation-resistant circuitry is reported. Specific areas discussed at length include semiconducting films, dielectric films, field-effect triodes, and thin-film diodes. D.E.W.

N65-13508# Joint Publications Research Service, Washington, D.C.
RADIATION AT THE SECOND OPTICAL HARMONIC
V. S. Mashkevich 28 Dec. 1964 8 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 9, no. 2, 1964 p 226–229
(JPRS-28002; TT-65-30000) OTS: $1.00

Mathematical models are presented for a quantum analysis of the problem of the generation of the second harmonic in crystals. In the case of strong generation, which occurs at a large power of radiation of the fundamental frequency, the essential role is played by reverse transformation of the second harmonic into the fundamental harmonic. In such a case, a quantum of the second harmonic is transformed into two quanta of the fundamental harmonic. The inadequacy of classical theory in this case is demonstrated. E.C.

N65-13613# Pennsylvania State U., University Park. Materials Research Lab.
RESEARCH ON ELECTRON-PHOTON INTERACTION PHENOMENA Interim Technical Report, 3 Jun.–2 Sep. 1964
H. K. Henisch 15 Sep. 1964 26 p refs
(Contract DA-44-009-AMC-581(T))
(ITR-1; AD-452833)

This report describes the initial work on a project concerned ultimately with the detection of radiation from the night sky. Preparations were made for measurements of short carrier lifetimes under infrared stimulus and for the exploration of photocapacitive effects. Equipment is being designed and assembled for the preparation of semiconductor heterojunctions. Theoretical calculations were made concerning the interface states at one-dimensional heterojunctions, and a review of this work is presented. Author

N65-13788# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE OBTAINING OF, AND CERTAIN PROPERTIES OF FILIFORM AND ACICULAR SINGLE CRYSTALS OF GERMANIUM AND SILICON, AND THEIR SOLID SOLUTIONS
A. V. Sandulova, P. S. Bogoyavlenskiy, and M. I. Dronyuk 28 May 1964 13 p refs Transl. into ENGLISH from Fiz. Tverd. Tela (Leningrad), v. 5, no. 9, 1963 p 2580–2586
(FTD-MT-64-44; AD-605894)

A new method is developed of obtaining filiform and acicular single crystals of germanium and silicon and their solid solutions, based on crystallizations from gas phase with the help of a solvent. This method makes it possible to grow so-called single crystals having various forms, lengths, and sections, and possessing great mechanical durability and a sufficient degree of homogeneity and perfection of structure. Author

N65-13801# Brown U., Providence, R.I. Engineering Div.
GRAIN BOUNDARY INFLUENCE ON CREEP AND ELASTIC RESPONSE, A SELF-CONSISTENT MODEL
Tai Te Wu Nov. 1964 18 p refs
(Contract AT(30-1)-2394)
(NYO-2394-11)

The region of the grain boundary in a polycrystal has quite different properties from those of the grain. A highly simplified two-dimensional model is proposed to examine the composite properties by the self-consistent method of continuum theory. The model consists of a matrix possessing the average properties of the grains and grain boundaries, in which is embedded just one cylindrical grain surrounded by an extremely thin viscous or elastic layer. An estimate thus is obtained for the influence of the grain boundary on the creep and the elastic behavior of polycrystals. Author

N65-13825*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
MECHANICAL RESONANCE DISPERSION AND STRESS-STRAIN BEHAVIOR OF SEVERAL IONIC SINGLE CRYSTALS
Edward R. Gotsky and Carl A. Stearns Washington, NASA, Jan. 1965 17 p refs
(NASA-TN-D-2566) OTS: HC $1.00/MF $0.50

The tangent modulus of the compressive stress-strain curve, at any stress level up to the inflection point, agrees well with the low-frequency dynamic modulus determined at the corresponding stress level by the Fitzgerald method. This agreement is attributed to the fact that in this stress range both the "static" and dynamic tests sample the internal dislocation configuration that gives rise to the foot on the stress-strain curve. Above the inflection point the dynamic modulus is higher than the tangent modulus determined at the same stress level.

For the first compression unloading curve and successive loadings and unloadings, the dynamic modulus is lower than the tangent modulus determined at corresponding stresses. Mechanical resonance dispersions observed in sodium chloride, potassium chloride, potassium bromide, and lithium fluoride are qualitatively similar to those reported by Fitzgerald for other single crystals. Author

N65-13844# Iowa State U. of Science and Tech., Ames. Ames Lab.
GROWTH OF GADOLINIUM SINGLE CRYSTALS
Idelle Marietta Peterson and Morton Smutz Jul. 1964 36 p refs
(Contract W-7405-ENG-82)
(IS-977)

Development of a method for growing single crystals of gadolinium, which might also be applicable to the other rare earths, is discussed. The strain–anneal technique for growing single crystals was used. A tapered rod specimen was used to obtain an approximate value of the most efficient value for the critical strain. This specimen was first annealed to remove existing internal stresses, then removed from the annealing furnace and strained in tension. After straining, the specimen was annealed for 3 days at 1200° C. The largest grains were observed in the 1.2% to 1.3% strain area of the tapered specimen. Five specimens of constant cross-section were also subjected to various annealing procedures and strains; the best single grains obtained were 3/8 inch and one inch long and extended across the whole specimen (0.320 in.). P.V.E.

N65-13886# Rensselaer Polytechnic Inst., Troy, N.Y.
MOLTEN CARBONATE ELECTROLYTES: ELECTRICAL CONDUCTANCE, DENSITY, AND SURFACE TENSION OF BINARY AND TERNARY MIXTURES
Anthony T. Ward and G. J. Janz Nov. 1964 21 p refs
(Contract Nonr-591(10))
(TR-22; AD-607200)

The electrical conductance, density, and surface tension of the alkali metal carbonate systems Li_2CO_3 (53.3 mole%)–Na_2CO_3 (46.7 mole%); Li_2CO_3 (42.7 mole%)–K_2CO_3 (57.3 mole%); Na_2CO_3 (58 mole%)–K_2CO_3 (42 mole%); and Li_2CO_3 (43.5 mole%)–Na_2CO_3 (31.5 mole%)–K_2CO_3 (25.0 mole%) are reported for the temperature range 500° to 900° C. Density and surface tension properties are approximately additive for these systems. The experimental conductances of the binary systems are found to obey the empirical equation: $\Lambda_{expt.} = (1-\theta)\Lambda_{Markov}$ where Λ_{Markov} is the equivalent conductance predicted by the Markov equation and θ is the Tobolsky parameter for the species: $[M_1{}^+CO_3{}^=]^-$ and $[M_2{}^+CO_3{}^=]^-$ in these mixtures. Author

N65-13921 Joint Publications Research Service, Washington, D.C.
THE LINE FORM OF NUCLEAR MAGNETIC RESONANCE IN A SOLID BODY
O. P. Revokatov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 274–277 refs (See N65-13892 04-07) OTS: $6.00

When investigating the crystalline structure of a solid body and the molecular motion inside the crystals by the method of NMR, it is necessary to record and measure the parameters of broad and low-intensity absorption line. The signal f(h) at the output of such a system is proportional to the coefficient of $\sin(\omega_m t)$ in the Fourier expansion of the function g(h) for the line form. The relation of a moment to an arbitrary order of the NMR lines and the amplitudes h_m were obtained separately for the second moment and for the fourth moment. P.V.E.

N65-14006# Rome Air Development Center, Griffiss AFB, N.Y.
PARAMAGNETIC RESONANCE ABSORPTION SPECTRA OF DIVALENT MANGANESE AND TRIVALENT IRON IN CALCITE Final Report
James G. Constantine Jul. 1964 89 p refs
(RADC-TDR-64-241; AD-609185)

The electron paramagnetic resonance absorption spectra, of divalent manganese and trivalent iron in single crystals of natural calcite, were observed at X-band frequencies. Careful relative intensity measurements of the doublet structure of these spectra, resulting from the difference in the crystalline electric fields at the two calcium (Ca^{++}) substitutional sites occupied by manganese (Mn^{++}) and iron (Fe^{+++}) ions, were made. These measurements showed that manganese does not preferentially occupy either of the two magnetically nonequivalent sites, and that iron preferentially occupies one site. In both cases, samples of approximately the same ion concentration were used. Additional spectra, identified as $\Delta M = \pm 1$, $\Delta m = 0$, ∓ 1; $\Delta M = \pm 2$, $\Delta m = 0$, ∓ 1; $\Delta M = \pm 3$, and $\Delta m = 0$, ∓ 1 for the manganese ion, were also observed. These spectra are 50 to 200 times weaker than the [$\Delta M = \pm 1$, $\Delta m = 0$] main manganese spectrum and do not saturate easily. Author

N65-14010# Thermo-Kinetic Corp., Tucson, Ariz.
THE ARTIFICIAL GROWTH OF SINGLE CRYSTALS OF CALCITE ($CaCo_3$ WITH A HIGH-DEGREE OF IMPURITY CONTROL Final Report, 1 Jul. 1963 – 30 Jun. 1964
Archie J. Deutschman, Jr. and James W. Berry Griffiss AFB N.Y., RADC, Sep. 1964 13 p refs
(Contract AF 30(602)-3137)
(RADC-TDR-64-344; AD-608974)

Doping of calcite by d.c. field sweeping resulted in low but significant levels of cationic contaminants ranging from 10 to 80 ppm. Hydrothermal growth of calcite was effected in a 12% aqueous ammonium nitrate system below 100° C. Spontaneously nucleated growth predominates, and small doped crystals of calcite can be prepared. Author

N65-14014 Philco Corp., Blue Bell, Pa. Philco Scientific Labs.
SOLID-STATE APPLICATION STUDY Final Report
Manfred Heil Griffiss AFB, N.Y., RADC, Oct. 1964 61 p refs
(Contract AF 30(602)-3037)
(RADC-TDR-64-375; AD-609120)

A theoretical and experimental investigation was conducted of the plasmalike properties of the charge carriers in solid-state materials to determine the feasibility of utilizing this pseudoplasma for amplification and generation of electromagnetic energy. Also studied was the feasibility of obtaining radiative transitions between excited states of impurity atoms in germanium and silicon. Interactions of the plasma with the following types of waves were considered; (1) slow transverse electromagnetic waves (helicon waves and extensions thereof), (2) longitudinal electric waves (plasma waves) and (3) fast transverse electromagnetic waves in the presence of parallel or crossed dc electric and magnetic fields. It was concluded that any radiation produced by a crossed-field configuration would be incoherent, though confined to a narrow band of frequencies. Author

N65-14036# General Telephone and Electronics Labs., Inc., Bayside, N.Y.
X-RAY DIFFRACTION MICROSCOPY OF IMPERFECTIONS IN SEMICONDUCTOR CRYSTALS Final Report
G. H. Schwuttke Apr. 1964 154 p refs
(Contract AF 19(604)-7313)
(AFCRL-64-542; TR64-302.15; AD-608335)

X-ray equipment was designed and built for (1) high-intensity X-ray diffraction microscopy by extinction contrast, (2) X-ray diffraction microscopy through scanning oscillator technique, and (3) direct observation of imperfections in semiconductor crystals through anomalous transmission of X-rays. This has enabled the high-speed recording of X-ray diffraction topographs of high resolution, and the recording of large-area topographs of entire crystal slices (30-mm diameter or larger) containing appreciable amounts of reversible elastic and/or frozen-in strains. With the use of these nondestructive techniques, silicon slices can be investigated for perfection at all stages of processing. Reported in detail are dislocation studies in diamonds, crystal defects in silicon solar cells, boron-induced microstrains in dislocation-free silicon crystals, partial dislocations in epitaxial silicon films, stacking fault structures in epitaxially grown silicon, misfit dislocations in epitaxial silicon, large-area stacking faults in Czochralski-grown silicon crystals, diffusion-induced dislocations in silicon, and dislocation barriers in diffused silicon layers. R.L.K.

N65-14038# Laboratory for Electronics, Inc., Boston, Mass. Solid State Electronics Lab.

RESEARCH IN FERROMAGNETICS Final Report No. 979-A3, 15 Dec. 1962–1 Mar. 1964

Robert J. Spain, Richard M. Hornreich, Harvey I. Jauvtis, Harrison W. Fuller, Chi-hsiang Lee et al [1964] 155 p refs

(Contract AF 19(604)-8349)

(AFCRL-64-655; AD-607270)

Results of research in the following areas is presented: (1) development of a theoretical model for calculation of the density of domain walls at remanence during hard axis switching in thin films; (2) theoretical analysis of a proposed logic device operating on the guided fallback principle; (3) the theory, operation, and fabrication of thin-film parametrons; (4) techniques for preparing films which exhibit smooth controlled wall motion; (5) magnetostatic coupling in permalloy films in a two-film structure; (6) design of three types of controlled-wall-motion shift registers; (7) a fast thin-film readout scheme using two orthogonal drive fields of different frequencies; (8) a thin-film analog-to-digital converter; and (9) dense, banded, microdomain structure observed in rotatable anisotropy films. D.S.G.

N65-14041# ITT Federal Labs., Nutley, N.J. Physical Sciences Lab.

RESEARCH ON SEMICONDUCTING DIAMONDS Final Report, Oct. 1961–Sep. 1964

G. R. Leef, D. C. Seeley, and H. G. Nordlin Sep. 1964 151 p refs

(Contract AF 19(628)-225)

(AFCRL-64-820; AD-608845)

The purpose of this work is to perform research to determine the inherent phenomena causing semiconductivity in diamonds, with special consideration for the rare natural type II-b material. In this work, resistivity and Hall coefficient were carefully measured on several type II-b samples over the temperature range of 100° to 900° K. The apparatus developed for these measurements is described. From these measurements, the activation energy of the principal acceptor level was determined for each specimen, and concentrations of donors and acceptors were deduced by a graphical method. The magnetoresistance and coefficient of magnetoresistance for one specimen in two orientations and at two temperatures are presented. Optical and electrical evidence of a polysynthetic twin structure is presented and discussed. Author

N65-14113# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.

SILICON CARBIDE, 500°C POWER RECTIFIERS Final Report, 1 Jul. 1962 – 31 Aug. 1964

R. B. Campbell, J. R. Davis, Jr., and L. J. Kroko Wright-Patterson AFB, Ohio, AF Avionics Lab., Nov. 1964 188 p refs

(Contract AF 33(657)-8719)

(AL-TOR-64-253; AD-608623)

Several crystal growth techniques were investigated for the fabrication of power rectifiers. These include the sublimation, thermal reduction, and modified Czochralski methods. Methods for obtaining larger crystals and controlling nucleation were extensively studied in the sublimation method. Crystals of high purity up to 15 mm across were grown. Junctions were formed in SiC by sublimation, diffusion, and epitaxial growth techniques. The sublimation-grown junction method was successful in preparing crystals for high-current capacity rectifiers. Sample rectifiers were prepared with a forward current capacity of 8 A, and a laboratory demonstration of a 10 A unit has been achieved. Device fabrication techniques, such as lapping, etching, contacting and encapsulation were developed for 10 A rectifiers. Author

N65-14115# John Hopkins U., Baltimore, Md. Carlyle Barton Lab.

RESEARCH OF DISCRETE ENERGY LEVELS IN SYSTEMS OF ATOMS Final Report, 1 Oct. 1963–Aug. 1964

R. L. Armstrong, J. B. Newman, and J. W. Whalen Wright-Patterson AFB, Ohio, AF Avionics Lab., Nov. 1964 18 p refs

(Contract AF 33(615)-1051)

(AFAL-TR-64-290; AD-608733)

Microwave absorption spectra of nitrogen trifluoride doped argon crystals, at 4° K, were taken in the 1B- to 49-Gc region. Using a model of the doped lattice which neglected exchange effects, absorptions greater than 3 dB were estimated. With a broadband apparatus, limited by a 1-dB sensitivity, no absorption was found. A machine program was written for the calculation of the uranyl overlap integrals that yields the Belfords' values. When Hartree–Fock–Slater, instead of the Hartree, uranium solutions are used, preliminary results show the pi overlaps are still larger than the sigma overlaps although differences between them are less. Infrared absorption spectra of rubidium uranyl nitrate, at 4° K, were taken, which contain absorption lines characteristic of the unit cell. These results are part of a larger study, which is continuing, of the behavior of two molecular systems, doped inert gas lattices, and uranyl salts. These investigations were undertaken because of the scientific problems involved and in an effort to find new useful materials for quantum electronics applications. Author

N65-14151# Wilkes Coll., Wilkes-Barre, Pa.

PRECISION MEASUREMENT OF INTERNAL FRICTION IN NON-METALLIC MATERIALS Final Report

D. P. Detwiler and S. J. Holden Wright-Patterson AFB, Ohio, ARL, Oct. 1964 32 p refs

(Contract AF 33(616)-8050)

(ARL-64-160; AD-608449)

Internal friction measurements were made on an outstandingly good quartz crystal. Several internal friction peaks are observed and discussed. In addition, a previously unreported anomaly was observed in the resonant frequency versus temperature curve for the quartz crystal. These measurements were made over a temperature range of approximately −125° to 300° C. The internal friction of sodium chloride was measured at room temperature in a free decay apparatus. Author

N65-14180*# Consultants and Designers, Inc., Arlington, Va.
ON THE NATURE OF THE FREE RADICALS OF THE COLD BOKKEVELD METEORITE [SUR LA NATURE DES RADICAUX LIBRES DE LA METEORITE COLD BOKKEVELD]
Jules Duchesne, Joseph Deprieux, and Clotile Litt 27 Nov. 1964 6 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci., Cosmochim. (Paris), v. 259, 1964 p 1891–1893
(Contract NAS5-3760)
(NASA-TT-F-9600; ST-CC-10251) OTS: HC $1.00/MF $0.50

The paramagnetic electronic-resonance signal, connected with the free radicals of the Cold Bokkeveld meteorite, offers numerous analogies with that characterizing the coals. A striking analogy is established in the behavior of these two types of rocks with regard to ionizing radiations. The whole of these correlations leads to the postulation that the carbonaceous compounds which constitute the meteorite in question would be, at least partially, the result of a biogenic activity. Author

N65-14200# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
RESONANT ENERGY TRANSFER FROM MERCURY TO ZINC IN RELATION TO A GAS LASER
Robert Mason Howard, Jr. (M.S. Thesis) Aug. 1964 71 p refs
(AD-603680) OTS: $3.00

An electronic system was constructed for scanning the spectral output of a Jarrell Ash spectrograph. This was used to observe the spectrum of an Hg-Zn discharge which originated from a heated dc glow discharge tube in which the partial pressures of Zn and Hg could be varied independently. Observations of the spectra indicate a resonant energy transfer from the 7^3S_1 state of Hg to the 4^3D_1 state of Zn at high voltages across the tube (anode to cathode). At lower voltages the 7^3S_1 Hg state couples to the 4^1D_2 state of Zn and indicates that a population inversion might be achieved in the Zn between the 4^1D_2 and 4^1P_1 state. Author

N65-14227# California U., Los Angeles.
RARE EARTH IONS IN CRYSTALLINE FIELDS Final Technical Report, Sep. 1, 1958 – Aug. 31, 1964
(Contract DA-04-495-ORD-1375; Grant DA-ARO-(D)-31-124-G75)
(AROD-2099-22; AD-609541)

The major results and conclusions of the experimental and theoretical studies of rare-earth ions (lanthanide and actinide) in crystalline fields are presented along with references to the publications in which they appear. Among the studies discussed are vibronic (electronic-vibrational) transitions of octahedral complexes, the f^2 configuration, U^{4+} ion spectra, fine structures of vibronic transitions at low temperatures, vibronic spectra of Pr^{3+} in $LaCl_3$ and $LaBr_3$, electronic spectra of Nd^{3+} in ethylsulfate crystals, absorption spectrum of Tm^{3+} in lanthanum ethylsulfate, and fluorescence spectrum studies. D.S.G.

N65-14284# Westinghouse Electric Corp., Youngwood, Pa.
GALLIUM ARSENIDE DENDRITE SINGLE CRYSTAL PROGRAM Final Report, Mar.–Dec. 1963
M. F. Amsterdam, R. H. Moss, S. O'Hara, R. K. Riel, H. F. John et al Wright-Patterson AFB, Ohio. AF Mater. Lab., May 1964 138 p refs
(Contract AF 33(657)-8162)
(MLTDR-64-129; AD-606891) OTS: $5.00

The results of experiments on dendritic and web growth of gallium arsenide are described and discussed. Solar-cell fabrication processes were developed which are ideally suited to webbed starting material. A solar cell made on gallium arsenide multidendrite web was comparable to those made on Czochralski crystal slices. GaAs was epitaxially grown on Ge web. Author

N65-14308# Tyco Labs., Inc., Waltham, Mass.
STUDY OF SURFACE STATES IN SEMICONDUCTORS
G. Rupprecht, J. Gilbert, and P. H. Smakula Griffiss AFB, N.Y., RADC, Oct. 1964 18 p refs
(Contract AF 30(602)-3157)
(RADC-TDR-64-346; AD-608989)

Using the pulsed field effect, surface-state studies were conducted on silicon surfaces oxidized by two methods, thermal oxidation in steam and anodic oxidation. The n-type samples which were thermally oxidized showed an activation energy of 0.51 eV, capture cross section of 3×10^{-16} cm^2, and density of $10^{10} cm^{-2}$. The anodically oxidized samples showed no evidence of surface states. Author

N65-14309# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
DETAILED STUDY OF DELETERIOUS EFFECTS ON SILICON TRANSISTORS Final Report
Ki Dong Kang Griffiss AFB, N.Y., RADC, Oct. 1964 61 p
(Contract AF 30(602)-3244)
(RADC-TDR-64-352; AD-609065)

Experimental work was done to study the surface effects on bipolar and unipolar devices—some with metal–oxide–silicon structures. The results are related to the models presented in previous reports. An additional mechanism is proposed for changes which occur in metal–oxide–silicon structures in which a field is present perpendicular to the surface. Author

N65-14348# Naval Research Lab., Washington, D.C. Electronics Div.
SOURCE CONTAMINATION EFFECTS ON THE EPITAXY OF Ge FILMS ON Ge
J. E. Davey 28 Sep. 1964 17 p refs
(NRL-6159; AD-607569) OTS: $0.50

The effect of source contamination on the structure of Ge films deposited simultaneously onto single-crystal Ge substrates and amorphous quartz Hall substrates was investigated. Deposition from the refractory metals, from quartz crucibles, and from extensively outgassed and vacuum-loaded graphite crucibles produce single-crystal films when deposited at a substrate temperature of 350° C; the electrical properties of the films deposited simultaneously onto the Hall substrates are typical of Ge films with good structural properties. Deposition from unoutgassed graphite crucibles (either resistive or radiative heating) and Al_2O_3 in either crucible or cataphoretic form, produce films ranging from amorphous to polycrystalline when deposited on single-crystal Ge at 350° C. Evaporations from these latter materials will produce single-crystal films on Ge single crystals only for extensive vacuum outgassing and vacuum loading of the Ge charge and for substrate temperatures in excess of 500° C. Author

N65-14359# New York U., N.Y. Radiation and Solid State Lab.
SOLID STATE RADIATION-INDUCED PHENOMENA Progress Report, Aug. 1, 1963–Feb. 28, 1964

Hartmut Kallmann Sep. 1964 48 p refs
(Contract DA-36-039-SC-90689)
(PR-2; AD-450813)

The theory of the ac impedance or of the apparent dielectric constant of a system containing poor conductors has been revised to take into account the diffusion of the charges inside the poor conductor. The equation for the capacity of the whole system is augmented by terms containing effective penetration depths of the field into the conductor, which are closely connected to the Debye lengths. In the investigation of injection and storage of charges in single CdS crystals, a comparison of the overall "persistent internal polarization" (PIP) on CdS crystals with those in powdered ZnCdS indicated that considerable PIP can be engendered in both, and that PIP in both can be released by light. The main respects in which they differed are presented. Efforts in the study of lifetime measurements of organic crystals and solutions have involved the measurement of energy transfer times from solvent to solute using the phase shift apparatus; the relationship between efficiency and lifetimes is discussed. D.S.G.

N65-14367# Ohio State U. Research Foundation, Columbus. Antenna Lab.
NONLINEAR INTERACTION OF LIGHT WAVES IN A DISPERSIVE DIELECTRIC
J. G. Meadors 13 Oct. 1964 30 p refs
(Contract AF 33(657)-10824)
(Rept.-1579-15; AD-450603)

The importance of crystal orientation in the achievement of nonlinear interactions in dielectrics is discussed and demonstrated through the analysis of realistic experiments. A theory of nonlinear interactions in dispersive dielectrics is given, in which beam divergence and frequency spread in the laser fields are treated rigorously. The results of the analysis clearly specify the limitations of the plane-wave theory and suggest an experiment which heretofore has not been performed. Author

N65-14376# Carnegie Inst. of Tech., Pittsburgh, Pa.
A NOTE ON THE SUSCEPTIBILITIES OF MANGANESE AND FERROUS FORMATE DIHYDRATES
Norikiyo Uryu 4 Aug. 1964 11 p refs Submitted for publication
(Contract Nonr-760(05))
(TR-25; AD-450233)

In discussing the magnetic susceptibilities of single crystal $Mn(HCOO)_2 \cdot 2H_2O$ and the powdered $Fe(HCOO)_2 \cdot 2H_2O$, the following facts are asserted and discussed: (1) The temperature dependence of the susceptibility can be described by a molecular field approximation of four sublattice models with antiferromagnetic exchange interactions. (2) The appearance of a small and sharp peak in the susceptibility curve should originate in the Moriya–Dzialoshinsky interaction. (3) The small anisotropy in the susceptibilities of manganese formate agrees reasonably well with the results of paramagnetic resonance observations in which the orthorhombic crystalline field parameters have been estimated. P.V.E.

N65-14408 Pennsylvania State U., University Park. Materials Research Lab.
KINETICS OF SOME SOLID STATE REACTIONS AT HIGH PRESSURE
Robert Joseph Zeto (Ph.D. Thesis, Sep. 1963) 10 Jul. 1964 78 p
(Contract Nonr-656(20))
(TR-18; AD-606957)

Discussed are a kinetic study of some solid-state reactions and the influence of both temperature and high pressure on the rates of transformation. The following polymorphic reactions were investigated with temperature to 700°C and pressure to 100 000 bars: SiO_2-quartz to SiO_2-coesite, SiO_2-cristobalite to SiO_2-coesite, SiO_2-cristobalite to SiO_2-quartz, crystallization of SiO_2-glass, crystallization of BeF_2-glass, crystallization of GeO_2-glass, and GeO_2-quartz to GeO_2-rutile. In addition, the reverse transformation of both SiO_2-coesite and BeF_2-coesite was investigated at high temperature and ambient pressure. Author

N65-14429*# Consultants and Designers, Inc., Arlington, Va.
FREE RADICALS IN CARBONACEOUS METEORITES [RADICAUX LIBRES DANS LES METEORITES CARBONEES]
Freddy Villee, Jules Duchesne, and Joseph Depireux 16 Dec. 1964 6 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 258, group 10, 1964 p 2376–2378
(Contract NAS5-3760)
(NASA-TT-F-9614; ST-CC-10263)

This is a study of electron spin resonance of carbonaceous meteorites, Alais and Cold Bokkeveld. It is emphasized that besides a ferromagnetic resonance, there exist narrow lines, attributed to the presence of free, organic radicals with a concentration of the order of 10^{16} per gram of carbon. The origin of these free radicals is discussed. Author

N65-14433# Stanford Research Inst., Menlo Park, Calif.
THIN-FILM COLD CATHODES FOR MICROWAVE TUBES Interim Report
D. V. Geppert and B. V. Dore Oct. 1964 43 p refs
(Contract AF 33(615)-1345)
(IR-3; AD-607915)

Sintered ZnO layers were investigated, using both cold-press and hot-press techniques. Ohmic contacts between platinum substrates and the ZnO layers were studied. The problem of obtaining blocking contacts between the ZnO and evaporated surface films was studied, and barriers up to 2.7 eV can now be obtained. Evaporated BaO was investigated as an activator for the surface films. Photoelectric work functions down to 1.75 eV were measured, and it is believed possible to reduce the work function down to about one eV by this technique. Life tests on ZnO diodes have continued and indicate no significant change in characteristics after almost 1000 hours of operation. Author

N65-14437# Radio Corp. of America, Princeton, N.J. RCA Labs.
INTERACTIONS OF COHERENT OPTICAL RADIATION WITH SOLIDS Final Report
R. Braunstein and N. Ockman 31 Aug. 1964 70 p refs
(Contract Nonr-4128(00); ARPA Order 306-62; Proj. Defender)
(AD-450756)

The following are discussed: (1) optical two-phonon absorption in semiconductors; (2) second-harmonic generation in the III–V compounds InP, GaAs, AlSb, and GaP; (3) frequency mixing in such semiconductors as Ge, GeAs, and Si; and (4) the frequency tuning of injection lasers by uniaxial stress. Included as appendixes are the following papers: (1) *Optical Double-Photon Absorption in CdS;* (2) *Frequency Tuning of GaAs Laser Diode by Uniaxial Stress;* and (3) *Effect of Doping on the Emission Peak and Absorption Edge of GaAs.* E.K.R.

N65-14441# Clevite Corp., Palo Alto, Calif. Semiconductor Div.
RESEARCH ON SEMICONDUCTOR TRANSPORT Annual Summary Report, 1 Oct. 1963–30 Sep. 1964
[1964] 5 p refs
(Contract Nonr-2934(00))
(AD-607492) OTS: $1.00

Main emphasis was put on "high field" experiments in which electrons interacting with phonons are accelerated to drift velocities that are larger than sound velocity in silicon. Specific results are presented in the following areas: (1) *Transmitted Phonon Drag Measurements in Epitaxial Silicon*; (2) *Acoustic Amplification of Relevant Thermal Phonons*; (3) *Determination of Sound Velocity in Silicon*; and (4) *Phonon Mean Free Path in Carbon Doped Silicon Crystals*. E.K.R.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-13450# Melpar, Inc., Falls Church, Va. Research Div.
MECHANISM OF MICROBIOLOGICAL CONTAMINATION OF JET FUEL AND DEVELOPMENT OF TECHNIQUES FOR DETECTION OF MICROBIOLOGICAL CONTAMINATION Quarterly Progress Report, 1 Sep.–1 Dec. 1963
Gordon C. Blanchard [1963] 124 p refs
(Contract AF 33(657)-9186)
(QPR-3; AD-606771)

The detection of microorganisms in fuel water environments and the mechanisms by which these microorganisms cause problem in fuel systems of aircraft are being studied. The laboratory detection methods studied were the esterase approach, tetrazolium reduction, O_2 consumption, and CO_2 evolution. Field detection approaches have been confined to the calibration of a pulse polarization technique using solutions in which aluminum corrosion is known to occur. The metabolism study is concerned primarily with defining the corrosion problem and determining the chemical changes which occur during the growth of microbes on fuel. Changes in the composition of fuel and water layers produced by microorganisms during growth were investigated. The changes in absorption of fuel before and after growth were characterized. The effect of growth on the O_2 and CO_2 levels of the fuel and the water phases of the growth medium were followed in open and closed systems. Author

N65-13511# Radiation Applications, Inc., Long Island City, N.Y.
RADIATION-INDUCED SOLID PROPELLANT DECOMPOSITION Technical Report, 1 Dec. 1962–30 Nov. 1963
George Odian, Terese Acker, Thomas Pletzke, Ernest Henley, and R. F. Mc Alevy, III 15 Jan. 1964 31 p refs
(Contract AF 49(638)-1125)
(RAI-331; AFOSR-64-1448; AD-604475) OTS: $2.00

An investigation of the effect of ionizing radiation on the burning rates and tensile strengths of various composite ammonium perchlorate propellants is reported. The tabulated results show that, in many cases, drastic changes in burning rate and tensile strength occurred upon radiolysis. A continuing study to elucidate the mechanism of these effects involves cobalt-60 gamma radiolysis of ammonium perchlorate over the dose range of 0 to 200 megarads and analysis for possible decomposition products, and the design of ballistic experiments with irradiated propellant systems. Analytical reactions and experimental procedures are treated at length. D.E.W.

N65-13578 Aerojet-General Corp., Sacramento, Calif.
TWO-DIMENSIONAL STRESS ANALYSIS OF SOLID PROPELLANT ROCKET GRAINS
Edward L. Wilson *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 9–26 refs (See N65-13577 04-34)

A numerical procedure for the two-dimensional stress analysis of solid-propellant grains subjected to internal and external pressures is presented. The procedure, which is based on the finite element method, has been programed for the digital computer. An automatic mesh generator allows the program to be used as a rapid design tool, since only the boundary geometry must be supplied as input. The method is illustrated by the analysis of two star grains. Results show excellent agreement with photoelastic analyses. Author

N65-13579 Purdue U., Lafayette, Ind.
A METHOD OF VISCOELASTIC STRESS ANALYSIS USING ELASTIC SOLUTIONS
R. A. Schapery *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 27–53 refs Sponsored by Lockheed Propulsion Co. (See N65-13577 04-34)
(Contract AF 04(611)-8539)

An engineering method of viscoelastic analysis is proposed that requires the use of only elastic solutions. Some numerical examples are given to demonstrate its accuracy and ease of application. In many practical cases, a viscoelastic response will be approximately equal to an elastic solution wherein elastic constants are replaced by reduced-time-dependent creep or relaxation functions. The familiar integral equations of linear thermoviscoelasticity are then reformulated in terms of dependent variables which satisfy homogeneous mechanical boundary conditions, and which are equal to the difference between these quasi-elastic solutions and the actual viscoelastic solutions. Following some considerations on superposition of the quasi-elastic and difference solutions in the presence of transient temperatures, three numerical examples are given: pressurization of reinforced hollow cylinder with a moving boundary; heating of a slab with temperature-dependent properties; and large deflection of a cantilever. Author

N65-13581 Explosives Research and Development Establishment, Waltham Abbey (Gt. Brit.)
THE SIGNIFICANCE OF TRANSIENT THERMAL STRAINS IN CASE BONDED ROCKET MOTORS
J. H. C. Vernon *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 75–90 refs (See N65-13577 04-34)

An analysis was made of the effects of thermal gradients in case-bonded motors, to determine the relative importance of transient and permanent thermal influences. Experimental studies on transient thermal effects in loose charges have been reanalyzed to enable better comparisons to be made with case-bonding effects. It is concluded that only in restricted

circumstances is a case-bonded grain likely to fail under circumstances where failure can be attributed to transient thermal effects alone rather than case-bonding effects. The results are described of a series of experiments in which attempts were made to induce failure under transient conditions. Author

N65-13583 Aerojet-General Corp., Sacramento, Calif.
STRESSES IN PROPELLANT GRAIN BOND SYSTEMS
R. N. Shearly and A. M. Messner *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group. on Mech. Behavior, Vol. I Oct. 1964 p 103–117 refs (See N65-13577 04-34)

Case-bonded solid-propellant grains are subjected to discontinuous stresses at the propellant-to-case bond interface. Bond failures frequently occur at the ends of these bonds, and mathematical difficulties have prevented a practical solution based on theoretical considerations. Two methods of resolving this difficulty are suggested in this paper, which also presents an example application of each technique. The first method involves comparisons of stress patterns obtained from numerical solutions which provide a relative measure of the effectiveness of various design details. The second procedure replaces the corner with an appropriate fillet. Numerical solutions are presented for a variety of fillet configurations, which are compared with the stress patterns obtained in sharp corner solutions. Author

N65-13584 Aerojet-General Corp., Sacramento, Calif.
STRUCTURAL ASPECTS OF MODULUS VARIATIONS WITHIN A SOLID PROPELLANT-GRAIN
A. M. Messner *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 119–130 refs (See N65-13577 04-34)

The modulus of elasticity of solid propellants can frequently be varied over a range of several hundred percent within a single grain, but the structural significance of such variations is not clearly defined. This paper describes a method of analyzing such systems and presents results of an exploratory study of some simple variable-modulus propellant grains. Problems were chosen to illustrate how control of this parameter can be exploited to improve the structural capability of these systems. The solutions indicate that significant strain reductions can be achieved in this manner and that inadequate control of this parameter could result in maximum strain variations as great as ±30% in some geometries. Author

N65-13586 Hercules Powder Co., Magna, Utah. Chemical Propulsion Div.
AN ANALOG SOLUTION TO VISCOELASTIC STRUCTURAL PROBLEMS
K. Stanley Cook and Robert N. Chappell *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Work Group on Mech. Behavior, Vol. I Oct. 1964 p 141–152 refs (See N65-13577 04-34)
(Contract AF 04(647)-243)

An analog computer solution to transient, viscoelastic structural problems is presented. The general form of a computer diagram for quasi-static problems is developed, and dynamic problems may also be analyzed by the same methods. The quasi-static and dynamic responses to internal pressurization of a viscoelastic propellant grain in an elastic case are given as examples. Computed results are compared with test results. The method utilizes the relaxation modulus rather than the complex dynamic modulus. Author

N65-13587 Explosives Research and Development Establishment, Waltham Abbey (Gt. Brit.)
THE NON LINEAR RHEOLOGY OF PLASTIC PROPELLANT
J. H. C. Vernon *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 153–168 refs (See N65-13577 04-34)

A plastic propellant is a composite propellant system based on polyisobutene binder; most current formulations contain 89% by weight of solids. At this level, rheological properties are markedly nonlinear, even at low strain levels, and this nonlinearity causes difficulties in stress analysis for motor applications. A brief review is given of attempts to characterize the material, to obtain empirical nonlinear flow equations, and to apply these to simple rocket-motor problems. An account is given of investigations into those aspects of the structure of the material which might account for nonlinearity in mechanical behavior. Author

N65-13589 Stanford Research Inst., Menlo Park, Calif. Propulsion Sciences Div.
APPLICATION OF FINITE ELASTIC THEORY TO PROPELLANT BEHAVIOR
James A. Rinde and Norman Fishman *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 177–190 refs (See N65-13577 04-34)
(Contract AF 04(611)-9559)

The equations derived by P. J. Blatz for compressible rubbery materials were applied to uniaxial extension data for carboxy-terminated polybutadiene and polyurethane propellants. Propellant response was adequately described by the analytical expressions at large strains; where extensive dewetting had taken place, reasonable values of Poisson's ratio and shear modulus were obtained. The supremum failure criterion

$$\sigma_{max} \leq \mu,$$

derived by Blatz, was examined in connection with polyurethane-propellant test results. In an effort to extend the applicability of finite elastic theory to propellant data at lower strains, equations similar to those of Blatz were derived using Rivlin's strain invariants I_1, I_2, and I_3. Author

N65-13590 Rocketdyne, McGregor, Tex.
VISCOELASTIC VIBRATIONS
J. D. Burton, W. B. Jones, and J. D. Frazee *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 191–201 refs (See N65-13577 04-34)
(Contract NOw-63-0591-d)

Fatigue testing of solid propellants has been conducted since it was discovered that prolonged, large amplitude, relatively high-frequency vibration of solid propellants caused structural failure of that viscoelastic material. Small models have been used for this testing to minimize the expense and complexity of the study program. One model used is a longitudinally-vibrating weighted column. Expressions developed from basic equations of motion were solved to give the response of the column. The solutions, while complex, consider body forces and describe the motion of a plane within the model as a function of time. Uniaxial tensile test data in the form of relaxation modulus curves have been transformed to determine parameters for a mathematical model used to describe the propellant properties in vibration. The relations were then evaluated to predict the model response. It is shown that predicted and experimental response are in good agreement. Author

N65-13591 Lockheed Propulsion Co., Redlands, Calif.
INVESTIGATIONS OF PROPELLANT DYNAMIC RESPONSE, VISCOELASTIC LINEARITY AND THERMORHEOLOGICAL BEHAVIOR
J. W. Jones and D. E. Cantey *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 203–244 refs (See N65-13577 04-34)
(Contract AF 04(611)-8539)

This paper discusses the correlation of dynamic moduli measured for uniaxial tension-compression and simple shear stress geometries, with moduli calculated from reduced variable tensile and shear-stress relaxation data. Viscoelastic heating effects under constant strain amplitude conditions are examined. Results of dynamic shear modulus measurements at 10^{-2} percent peak strain obtained on a piezoelectrically driven test device are discussed, along with dynamic bulk modulus measurements on the same propellant under conditions of superposed hydrostatic pressure. Transient viscoelastic response and thermorheological behavior of a variety of polybutadiene acrylic acid (PBAA) and carboxy-terminated polybutadiene propellants are presented as measured by stress relaxation and creep techniques. Propellant formulations investigated included variations in oxidizer specific surface area as well as cross-linker functionality and concentration for the two polymer types. Nonlinear responses observed in both transient and dynamic tests are described, and their effects on analysis techniques are discussed. Author

N65-13593 Stanford Research Inst., Menlo Park, Calif. Propulsion Sciences Div.
DEVELOPMENT OF A DILATATIONAL EQUATION-OF-STATE
Norman Fishman and James A. Rinde *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 267–289 refs (See N65-13577 04-34)
(Contract AF 04(611)-9559)

Volume change data obtained from dilatometric studies of two propellant compositions were used to develop a dilatational state equation that interrelates volume ratio, strain energy, and time. The general form of the equation is

$$\log V/V_o = A[\log W + B(\log t/b_T) + C(\log t/b_T)^2]^n$$

where W is the area under the uniaxial stress–strain curve, t is the time in minutes, and b_T is a temperature shift factor not necessarily equal to the WLF factor a_T. Equation constants were determined by empirical fitting of constant strain rate test data, and the equation thus developed was used to calculate volume changes resulting from constant load and constant loading rate tests. The good agreement between calculated and experimental results demonstrates that the state equation is path independent and can be used to predict the extent of dewetting resulting from any history of applied load if the path is definable in terms of strain energy and time. Author

N65-13594 Aerojet-General Corp., Sacramento, Calif.
STRAIN DILATION IN SOLID PROPELLANTS
R. J. Farris *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 291–302 refs (See N65-13577 04-34)

A stochastic model was developed that accurately describes both the stress–strain and dilatation–strain relationships of solid propellants in terms of their frequency of dewetting. This model enables us to calculate the frequency of dewetting vs strain from the dilatation–strain relationship. Comparison of the stress–strain and dilatation–strain relationships of various propellant systems shows that the model is consistent with the data presented. Author

N65-13595 Army Missile Command, Huntsville, Ala.
EFFECT OF FILLER CONCENTRATION ON THE VISCOELASTIC RESPONSE OF A FILLED POLYMER SYSTEM
Donald L. Martin, Jr. *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 303–316 refs (See N65-13577 04-34)

An investigation was conducted to determine the effect of volume fraction of filler on the viscoelastic response of the PBAA propellant system. Formulations containing up to 84% filler fraction were investigated in uniaxial tension with strain rates ranging from 0.05 to 5.0 in./in. min and temperatures from 180° to −90° F. The addition of filler particles resulted in an increase in the maximum stress, modulus, strain energy density at failure, and stress–strain relationship, with a corresponding decrease in the strain capacity. These data were corrected for the volume fraction of filler and correlated by use of temperature and filler fraction shift factors introduced in the construction of a doubly reduced time scale of the mechanical response spectrum. Empirical formulas were derived for the dependence of the filler fraction shift factor and the filler-induced strain concentration factor on filler fraction. Mechanical response spectrums are presented for maximum stress, modulus, strain and strain energy density at failure, and the stress–strain relationship, indicating the dependence of these parameters on strain rate, temperature, and filler fraction. Author

N65-13596 Lockheed Propulsion Co., Redlands, Calif.
DIELECTRIC AND ELECTRICAL CONDUCTIVITY PROPERTIES OF CERTAIN SOLID PROPELLANTS
D. E. Cantey *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 317–344 refs (See N65-13577 04-34)
(Contract AF 04(611)-8539)

Dielectric spectroscopy was investigated as an analytical tool to assist in the elucidation of chemicophysical effects in solid propellant systems. Complex dielectric properties were measured over a wide temperature range and at frequencies from 50 to 10^5 cps for polybutadiene acrylic acid (PBAA), carboxy-terminated polybutadiene (CTPB), and nitrocellulose-base propellants and ingredients. The measurement range was extended to low frequencies by measurement of dielectric absorption response to step function d.c. potentials over time ranges from 10 to 10^6 seconds. Spectral response of the complex dielectric constant storage and loss components is interpreted in terms of classical electrical polarization mechanisms. Author

N65-13597 Aerojet-General Corp., Sacramento, Calif.
NONDESTRUCTIVE WAVE-PROPAGATION METHOD FOR MEASURING CURE AND MECHANICAL PROPERTIES OF SOLID PROPELLANTS
G. J. Kostyrko and R. E. Lee *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 345–356 refs (See N65-13577 04-34)

A low-frequency sonic wave-propagation method is being developed for the in situ monitoring of cure and mechanical properties in large solid-propellant motors. Standard ultrasonic methods are not applicable to solid propellants because these materials are highly attenuative at high frequencies. A simplified theory of wave propagation is presented with a discussion of its application to propellant. One of the sonic and low-frequency ultrasonic methods that has been developed utilizes a continuous series of 66 to 350 kc sinusoidal bursts from a pulse generator. An oscilloscope is used for signal display. Tests of several batches of polybutadiene propellants with different cross link ratios showed a relationship between the signal transmitted through the propellant and the Instron tensile properties such as modulus, elongation at maximum stress, and elongation at break. A relationship was also found between the output signal and propellant cure, as indicated by Shore hardness. Author

N65-13598 Rocketdyne, McGregor, Tex. Solid Rocket Div.
TRIAXIAL TENSILE FAILURE OF SOLID PROPELLANTS
B. C. Harbert *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 357–370 refs (See N65-13577 04-34)

This paper reports progress in measuring propellant failure criteria in a triaxial tensile stress field by the "poker chip" method. In this test, a thin disk of propellant, bonded between two parallel flat rigid circular plates, is pulled apart in a direction perpendicular to the surface of the plate. Successful application of this method to determine propellant failure criteria depends on: a) maintenance of uniform deflection across the specimen and b) identification of the stress and strain and geometric point at which failure initiates. Axial displacement is measured at three equally spaced points around the specimens by a technique described in the paper; the test record then indicates whether or not uniform deflection has been achieved. Radial displacement is also measured, from which volume change can be calculated. Additionally, an attempt was made to obtain a sonic indication of the failure initiation event by application of a ceramic audio pickup mounted on the specimen. The point of failure initiation was inferred by analysis of the stress–strain curve, the volume change–strain curve, and inspection of the sample after the test. Author

N65-13599 Lockheed Propulsion Co., Redlands, Calif.
PROPELLANT FAILURE MECHANISMS
J. W. Jones *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 371–394 refs (See N65-13577 04-34)
(Contracts NAS7-241; AF 04(611)-8539)

Propellant failure characteristics were measured in uniaxial and biaxial stress states for PBAA and Nitroplastisol propellants, and failure conditions were examined over a wide range of temperatures. The observed failure conditions were compared to various failure criteria, and it was found that a maximum tensile stress criterion accurately resolved the data for uniaxial tensile, biaxial tension–tension, simple shear, and biaxial tension–compression stress states. The experiments gave indications of the granular reactions of the solids during deformations to failure in tests made in the biaxial, tension–compression mode. Examination of the influence of temperature on the multiaxial failure characteristics of propellant gave evidence to support the applicability of the maximum stress failure criterion over wide ranges of temperatures. In studies of the effect of binder and oxidizer variations on failure, it was found that reasonable agreement with the maximum tensile stress criterion was obtained for wide variations in formulations. Author

N65-13600 Aerojet-General Corp., Sacramento, Calif.
A UNIFIED APPROACH TO FAILURE AND ITS APPLICATION TO SOLID PROPELLANT MATERIALS
J. N. Majerus *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 395–420 refs (See N65-13577 04-34)

Two interrelated general approaches to the study of structural failure of solid propellants are described. These consist of the macroscopic (thermodynamics and continuum mechanics) and microscopic (molecular model) methods of analysis in conjunction with solid propellant experimental data. The thermodynamic investigation indicates that propellant material under loading goes through stages of stable and unstable behavior that depend upon the rate at which work is absorbed and dissipated by the material. The instability point seems to correlate with results from subscale motors. The thermodynamic investigation is then extended by a functional analysis of failure treated from a viewpoint of continuum mechanics. Since fracture, per se, is a physical observable, it is represented by a state vector in n-dimensional space. The number of dimensions of this space depends upon the basic variables involved in fracture. Since the correct failure criteria must be tensorally consistent with the tensor rank of fracture, distinct sets of functions can be applied to experimental data. The data are compared to the classical scalar functions of failure. Author

N65-13601 Thiokol Chemical Corp., Brigham City, Utah. Wasatch Div.
THE EFFECTS OF FATIGUE LOADING UPON SOLID PROPELLANT
Joseph H. Stoker *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 421–436 refs (See N65-13577 04-34)

Experimental data were gathered on a typical composite solid propellant under dynamic tension–tension constant amplitude loading. The effects of temperature upon the fatigue properties of propellant are pronounced. These effects are large because of the net energy that is absorbed during cyclic loading in materials that have internal damping. The effects of strain amplitude, temperature, and dynamic frequency from zero to 50 cps were investigated. The failure modes were determined and related to the results of other test methods. These failure modes were shown to be normal fatigue crack propagation with no evidence of slumping or loss of structural integrity due to temperature effects. Author

N65-13602 California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.
ON THE PROPAGATION OF FAILURE IN A BIAXIAL STRESS FIELD
W. G. Knauss *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 437–454 refs (See N65-13577 04-34)
(Grant NsG-172-60)

Failure data obtained in a biaxially stressed strip geometry can lead to conservative estimates of load capability in solid

propellant rockets. A theory of strength in viscoelastic materials is reviewed and used to correlate rate-dependent uniaxial tensile properties with the motion of a crack in a biaxially stretched sheet. Agreement between experiment and theory is satisfactory. A comparison of experimental data on Butarez unfilled and filled slightly with carbon black shows that the filler affects the velocity of crack propagation but not the long-time strain capability. Author

N65-13603 Aerojet-General Corp., Sacramento, Calif.
A STATISTICAL APPROACH TO FAILURE CRITERIA
H. P. Briar and J. H. Wiegand *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 455–468 refs (See N65-13577 04-34)

The incidence of motor failures with increasing severity of exposure, as in the case of motors cycling to lower and lower temperatures, can be examined as a statistical distribution. This is facilitated by generalization of the data for any motor in terms of the strains and stresses experienced with respect to the critical propellant-failure properties. The use of several properties usually measured on propellants is examined, and the degree of correlation is shown as an empirical argument for selection of a failure criteria to use. Strain-failure distributions for small motor cracking and Instron strain-failure distributions are shown to be normally distributed, whereas the time to failure of specimens at constant tensile strain is shown to follow the failure rate distribution suggested by Coleman for tensile failure of yarn specimens. Author

N65-13604 Imperial Metal Industries, Ltd., Kidderminster (Gt. Brit.) Summerfield Research Station
FAILURE CRITERIA FOR CAST-DOUBLE-BASE PROPELLANTS
H. Leeming and A. Parker *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 469–500 refs (See N65-13577 04-34)

Simple failure theories are considered for cast-double-base propellants based on a maximum stress criterion of failure at low temperatures and high strain rates and a maximum strain criterion of failure at high temperatures and low strain rates. The form of the reduced failing stress–time locus is deduced from a knowledge of the reduced relaxation modulus curve, together with a simple empirical equation for nonlinearity. For complex tensile tests in which several strain rates are used, these simple failure theories do not suffice, and a cumulative damage theory based on energy considerations is necessary to obtain good agreement with experimental data. A reduced failing energy–strain rate locus is obtained in a similar manner to the reduced modulus or compliance curves. The predictions of these various failure theories are compared with experimental data from simple tension, biaxial tension, and small-scale rocket motor tests. Author

N65-13805 California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.
FAILURE THEORY FOR POLYMERIC MATERIALS UNDER GENERAL MULTIAXIAL LOADING CONDITIONS
A. R. Zak *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 501–527 refs (See N65-13577 04-34)
(Contract AF 33(616)-8399)

A review is presented of the theoretical work in the area of viscoelastic failure of amorphous polymer materials. From this discussion a conclusion is drawn that a multiaxial failure criterion is at present nonexistent for a viscoelastic material. Consequently, an attempt is made to develop such a criterion. An engineering theory is developed which is designed to predict failure under general multiaxial conditions from uniaxial viscoelastic failure data. The theory is shown to be consistent with available uniaxial experimental data and, comparing the theory with this data, a certain unknown function is evaluated. Using this function the theory is extended to obtain a failure criterion under multiaxial stress conditions. Author

N65-13607 Lockheed Propulsion Co., Redlands, Calif.
MOIRE METHOD FOR THE MEASUREMENT OF STRAINS IN SOLID PROPELLANTS
W. D. Hart *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 545–560 refs (See N65-13577 04-34)
(Contract NAS7-241)

Procedures are described which demonstrate the use of Moiré fringes for assessment of various experimental methods of propellant physical testing to obtain parameters for the structural analysis of solid grains. A description of experimental work using the Moiré method for the measurement of local strains around circular holes in propellant slabs in biaxial stress fields is given. The experimental data show the excellent resolution which may be obtained in local areas of strain concentration in propellant materials. Work is described which demonstrates the application of the Moiré method to measure strains on curved surfaces. This technique entails the use of "paste-on" Moiré gages which can be prepared in the laboratory and subsequently applied to a curved or planar propellant surface. Author

N65-13619# Stanford Research Inst., Menlo Park, Calif.
VISCOELASTIC PROPERTIES OF SOLID PROPELLANTS AND PROPELLANT BINDERS Annual Technical Summary Report, Jul. 16, 1963–Sep. 15, 1964
Nicholas W. Tschoegl, James R. Smith, and Thor L. Smith
15 Oct. 1964 55 p refs
(Contract NOw-64-00730-d; ARPA Order 22)
(Rept.-4; AD-452309)

Solid propellant investigations concerning dynamic shear properties, bulk compressibility, and tensile properties at constant strain rates are discussed. Important aspects of studies of dynamic shear properties include development of a differential Lissajous method for the precise determination of phase angle, and an evaluation of the dependence of the complex shear modulus of an SBR vulcanizate, and a polyurethane propellant on specimen thickness and laterally applied pressure. Methods for correcting data are presented along with some data obtained at various strain amplitudes on SBR specimens. A qualitative discussion is given of the dependence of specific volume on pressure, temperature, and time, and also of data obtained previously on two propellants. Static and dynamic compressibility apparatus are described. Tensile data obtained at various strain rates and temperatures on end-bonded specimens of a PBAN propellant are analyzed by methods applied previously to a polyurethane propellant. Included is an evaluation of the effective gage length of the end-bonded specimens. The gage length was found to vary randomly with test conditions, and thus is not a constant as commonly assumed. Author

N65-14027# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOLID ROCKET PROPELLANTS

Dorde Jaukovic 12 Oct. 1964 21 p Transl. into ENGLISH from Vojnothnicki Glasnik (Yugoslavia), no. 8, 1963 p 581–590
(FTD-TT-64-744/1+2; AD-450972)

Discussed are (1) the advantages of solid fuel propellants in rockets for military purposes; (2) an evaluation of effectiveness of rocket engines; (3) the composition and manufacture of solid propellants; (4) physical and mechanical characteristics of solid propellants; and (5) the rate and mechanics of combustion. R.L.K.

N65-14032# Stanford Research Inst., Menlo Park, Calif.
HIGH ENERGY OXIDIZERS IN SOLUTION Quarterly Progress Report, 1 Jul.–30 Sep. 1964
W. E. Tolberg, R. S. Stringham, and M. E. Hill 2 Nov. 1964 25 p
(Contract AF 04(611)-9370; ARPA Order 24)
(QPR-5; AD-451737)

Study was continued on the reaction apparently observed when NF_3 is added to liquid anhydrous HF containing dissolved fluorine. NMR spectra have shown that F_2 and NF_3 are consumed in the reaction to form a new species which exchanges fluorine with the solvent. The NMR spectra of the reaction system also indicate the presence of paramagnetism that was later confirmed in EPR experiments. No conclusive structure information on the new species has yet been obtained. Author

N65-14033# Stanford Research Inst., Menlo Park, Calif.
SOLID PROPELLANT MECHANICAL PROPERTIES INVESTIGATIONS Final Report, 1 Oct. 1963–1 Oct. 1964
Norman Fishman and James A. Rinde 2 Dec. 1964 75 p refs
(Contract AF 04(611)-9559)
(Rept.-12; AD-608838)

This research, relating mechanical behavior and failure mechanisms to processes of propellant microstructure, consisted primarily of determining lateral dimensions by measuring volume changes while carrying out tests under varying conditions of load, temperature, time, and humidity. One approach used to analyze the test data was to define the physical state of the deformed propellant by means of path-independent dilatational state equations which interrelate volume ratio, strain energy, and time. The equations of finite elastic theory were also applied to propellant behavior. Results suggested that a criterion for uniaxial failure in a propellant of high solids content is a minimum lateral area governed by maximum packing density. R.L.K.

N65-14288 Goodyear Tire and Rubber Co., Akron, Ohio.
PROPELLANT ADHESIVES RESEARCH Second Quarterly Report, 22 Apr.–11 Jul. 1964
28 Aug. 1964 17 p ref Prepared for Hercules Powder Co.
(Rept.-19-399; AD-450298)

The study of fundamental factors pertaining to adhesives for bonding double-base propellants to substrates was continued. The previously developed solvation test was used to investigate the effects of chemical cross-linking and formulary variation. Ten new adhesive prospects were selected for further study. The results of preliminary testing of a new all-plasticizer liquid indicated that it is a powerful solvating agent and merits further consideration as a laboratory screening medium. Author

N65-14416# Picatinny Arsenal, Dover, N.J.
DESENSITIZATION OF HMX FOR USE IN XM29 PROPELLANT
Charles E. Mc Knight and Maurice Baer Oct. 1964 20 p
(TR-3198; AD-450744)

The sensitivity data show that coating with lead stearate will desensitize the HMX enough to reduce or remove the hazards involved in handling. The burning rate results show that the process modifications required to introduce HMX as coated material are without adverse effect on the propellant. This was further substantiated by ballistic tests of 12 propellant grains. Author

N65-14430*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
BIBLIOGRAPHY ON FLUORINE AND FLUORINE OXYGEN OXIDIZERS FOR SPACE APPLICATIONS
J. H. Cabaniss 16 Oct. 1964 78 p refs
(NASA-TM-X-53149) OTS: HC $3.00/MF $0.75

This bibliography references approximately 350 reports on fluorine and fluorine–oxygen mixtures (FLOX). In the introduction, current Government contracts pertaining to FLOX and fluorine are listed. The bibliography includes separate sections dealing with material compatibility; handling, storage, disposal, and safety considerations; physical and chemical properties; propellant oxidizer studies; vehicle component design studies; and miscellaneous reports. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-14068# Atlantic Research Corp., Alexandria, Va.
FEASIBILITY DEMONSTRATION OF PYROLYTIC GRAPHITE COATED NOZZLES Third Quarterly Progress Report, 1 Aug.–31 Oct. 1964
James D. Batchelor 25 Nov. 1964 19 p refs
(Contract AF 04(611)-9708)
(RPL-TDR-64-176; AD-608721)

In the current work, nozzles of 1.1-inch and 2.3-inch diameter are to be tested with a 6550° F propellant. Improvements were made in preparing crack-free subscale coated inserts. Flaw-free coatings as thick as 54 mils were prepared. Application of this improved art to full-scale inserts is underway. Stress analysis indicated the merit of alternate substrate materials, and deposition work with these is underway. A successful 35-second subscale firing was made, but during a 60-second firing discrete coating losses were observed. In the first full-scale motor firing excessive erosion was observed from a coating containing a known separation. This behavior was analogous to early subscale experience. Author

N65-14110# Thiokol Chemical Corp., Brigham City, Utah. Wasatch Div.
156 IN. DIAMETER MOTOR MOVABLE NOZZLE TVC PROGRAM Technical Note, 16 Jun.–15 Sep. 1964
E. G. Dorsey [1964] 63 p
(Contract AF 04(695)-363)
(RTD-TDR-63-1125; AD-453148)

The forward and aft segments of the 156-in. motor case were successfully hydrotested. The center segment was insulated with uncured rubber, was cured, and inspected, and the necessary rework was begun. Fabrication of the high temperature plastic and the steel parts for the 156-1 nozzle were initiated. The actuators for the 156-1 motor static test were fabricated and are being subjected to functional tests. Rework of the servomechanisms to improve vibration sensitivity was found necessary. Functional testing of the igniter carriage was completed. All ignition work is complete except for temperature cycling and static testing of one igniter as a verification round. All remaining processing and handling tooling for the 156-1 motor is in use. All facility modifications were completed, and the 200-ton cranes installed in the manufacturing and test areas have completed load testing satisfactorily. Author

N65-14121*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL EFFECTS OF PROPELLANT-INTRODUCTION MODE ON ELECTRON-BOMBARDMENT ION ROCKET PERFORMANCE
Paul D. Reader Washington, NASA, Jan. 1965 25 p refs
(NASA-TN-D-2587) OTS: HC $1.00/MF $0.50

Several propellant-injector designs that were investigated included reverse-, cross-, side-, and angle-feed modes in which the propellant-injection apertures were located on the ion-chamber periphery near the extraction electrodes. Ion chambers of 10- and 20-cm diam were used, and the experimental results were compared with previously conceived through-feed designs. All these new injector modes resulted in ion-chamber performance that was improved over that of the through-feed mode. Discharge losses were as much as 25% lower, and the ion-current profile at the extraction plane was more uniform. Author

N65-14401*# Electro-Optical Systems, Inc., Pasadena, Calif.
ION ROCKET SYSTEM RESEARCH AND DEVELOPMENT Quarterly Report, 1 Sep.–30 Nov. 1964
R. C. Speiser, G. Sohl, and G. C. Reid 20 Dec. 1964 58 p
(Contract NAS3-5250)
(NASA-CR-54027; EOS-4920-Q-3) OTS: HC $3.00/MF $0.75

Work performed in the third quarter of a research and development program on an electron bombardment cesium-ion rocket system is reported. Electrode material studies and a long-duration engine system test with an aluminum accelerating electrode are described. Performance parameters of improved permanent magnet engines are reported, and plasma distribution studies and autocathode tests are discussed. Author

N65-14402*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
THIRTY KILOWATT PLASMAJET ROCKET ENGINE DEVELOPMENT. THIRD YEAR DEVELOPMENT PROGRAM Summary Report, 1 Jun. 1963–31 May 1964
S. Bennett and L. A. Cass 2 Jul. 1964 245 p refs
(Contract NAS3-2593)
(NASA-CR-54079; RAD-TR-64-42) OTS: HC $6.00/MF $1.50

Thirty kilowatt radiation-cooled arcjet engines were tested for 30 days at 1000 second I_{sp}, 10 days at 1300 second I_{sp}, and 120 hours at 1500 second I_{sp}. The measured efficiency range was 40 to 45 percent. Results of an extensive high-temperature bonding study are reported. At the 200-kilowatt power level, a specific impulse level of 2000 seconds was reached with a radiation-cooled engine, and a specific impulse level of 7400 seconds was reached with a liquid-cooled engine—also in the 40-percent efficiency range. Probe measurements were made in the 30-kilowatt engine exhaust, and are compared with predictions of the core flow model. Measurements were made of the constricted arc voltage gradient. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-13371# Pennsylvania State U., University Park. Ionosphere Research Lab.
SOLAR RADIO FLUX DURING THE IQSY AT UNIVERSITY PARK, PENNSYLVANIA Scientific Report, Jul.–Sep. 1964
J. P. Hagen 10 Feb. 1965 21 p
(NSF GP-2986)
(SR-234(D))

This report contains solar radio flux density data for July, August, and September, 1964. The July data were taken at 3035 Mc/sec. The August and September data were taken at 9300, 960, and 3035 Mc/sec. A description of the receivers used at the various frequencies is given. Author

N65-13551*# Consultants and Designers, Inc., Arlington, Va.
SOLAR CORONA EMISSION IN THE SPECTRUM REGION $\lambda < 10$Å [IZLUCHENIYE SOLNECHNOY KORONY V OBLASTI SPEKTRA KOROCHE 10 A
E. P. Fetisov 10 Jun. 1964 6 p refs Transl. into ENGLISH from Astron. Yh. (Moscow), v. 41, no. 2, 1964 p 299–301
(Contract NAS5-2078)
(NASA-TT-F-9009; ST-SP-10153) OTS: HC $1.00/MF $0.50

The spectral emission flux of the corona in the $\lambda < 10$ Å region has been determined theoretically. Considered are the line, recombination, and bremsstrahlung emissions. The continuous emission from heavy ion recombinations prevails. The theoretical flux is less than that observed, which is evidence of corona's high nonhomogeneity. Author

N65-13573*# National Aeronautics and Space Administration, Washington, D.C.
SEARCH FOR A NEW EMPIRICAL FORMULA FOR THE REPRESENTATION OF THE VARIATION OF THE INTENSITY OF SOLAR RADIATION WITH ZENITH ANGLE
A. Bemporad Jan. 1965 19 p Transl. into ENGLISH from Met. Z. (Braunschweig), v. 24, Jul. 1907 p 306–313
(NASA-TT-F-302) OTS: HC $1.00/MF $0.50

An empirical formula, relating solar intensity (or solar irradiance) to apparent solar zenith angle, for an observer at arbitrary altitude is given. The superiority of this formula, especially at large zenith angles is demonstrated by comparison with actual measurements. A procedure is given for quickly approximating the constants in the formula, for a single observer location, from three observations at widely different solar zenith angles. To facilitate this procedure, a table of optical air mass and related functions of zenith angle is provided. Author

N65-13893 Joint Publications Research Service, Washington, D.C.

PHYSICAL CONDITIONS IN THE NEIGHBORHOOD OF THE SOLAR SYSTEM ACCORDING TO DATA FROM MEASUREMENTS OF THE POLARIZATION OF COSMIC RADIOEMISSION

V. A. Razin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 1-5 refs Presented at Conf. on Radioastronomy, Gor'kiy, 28 Feb. 1963 (See N65-13892 04-07) OTS: $6.00

The Faraday rotation of the plane of polarization of cosmic radio emission was used in the analysis of the medium in the neighborhood of the solar system. Polarization measurement data for a frequency of 207 Mc during a few months in 1957, 1961, and 1962 were collected by stationary parabolic antennas for a celestial bandwidth with mean declination of +22°. The differences in the evaluated data led to the conclusion that an extensive corona of ionized gas forms around the solar system during periods of maximum solar activity and decreases significantly during periods of minimum solar activities. G.G.

N65-13894 Joint Publications Research Service, Washington, D.C.

EFFECTIVE TEMPERATURE OF THE LUNAR SURFACE DUE TO REFLECTION OF COSMIC RADIOEMISSION FROM IT

A. M. Starodubtsev *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 6-15 refs (See N65-13892 04-07) OTS: $6.00

The effective temperature of the lunar surface is calculated by using the reflection of cosmic radio emission at frequencies of 100, 200, and 400 Mc. As a lunar model, a sphere with an ideally smooth surface of material was examined whose dielectric constant was between 1.5 and 4. From calculations, it follows that with an increase in the angle-of-ascension of the moon, the average brightness temperature varies slightly, and only in the region of the angles $\alpha = 280°$ does some temperature increase occur; the degree of polarization of the radiation reflected from the lunar surface is almost independent of the frequency, and for $\Sigma = 1.5$ does not exceed 12% and averages out to about 2% to 5%. Author

N65-13913 Joint Publications Research Service, Washington, D.C.

MEASUREMENT RESULTS OF THE RADIOEMISSION INTENSITY OF A SERIES OF DISCRETE SOURCES, THE MOON, AND JUPITER AT A WAVELENGTH OF 70.16 CM

A. V. Zakharov, V. D. Krotikov, V. S. Troitskiy, and N. M. Tseytlin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 231-234 refs (See N65-13892 04-07) OTS: $6.00

The measurements of the radio emission of discrete sources with reference to Cassiopeia-A were carried out by a number of observers, and included wavelengths close to 70 cm. However, for the composition of the spectra of discrete sources, identical methods of investigation are necessary by means of precision measurements and use of the artificial moon method for the most powerful sources, and their subsequent comparison with weak sources. The present measurements of the radiation intensity of discrete sources are devoted to the partial fulfillment of this problem. Measurements of the radio emission temperature of the Moon and Jupiter are more precise than the available, meager, experimental data at wavelengths of $\lambda \sim 70$ cm of other investigators. Author

N65-13914 Joint Publications Research Service, Washington, D.C.

MEASUREMENT RESULTS OF THE RADIOEMISSION OF THE MOON AT A WAVELENGTH OF $\lambda = 1.6$ CM

D. A. Dmitrenko, S. A. Kamenskaya, and V. L. Rakhlin *In its* Izv. VUSov: Radiophys., Vol. VII, No. 3, 1964 25 Nov. 1964 p 235-237 refs (See N65-13892 04-07) OTS: $6.00

Measurements of the phase variation of the moon at a wavelength of $\lambda = 1.6$ cm were carried out by the artificial moon method. A modulated radiometer of the superheterodyne type was used, with parametric amplification at the input. The fluctuating sensitivity threshold of the radiometer was equal to 0.15° K for a time constant of the output apparatus of $\tau = 16$ sec upon which all measurements were carried out. The antenna system consisted of a parabolic reflector with a diameter of 1.5 m and an excitor for a receiver for horizontal polarization. The directivity pattern for the antenna system relative to the solar radiation was 49 ft at a level of 3 dB. In order to compensate for the noise signal, the second input of the radiometer was equipped with a horn system directed at the zenith. Author

N65-14192# Max-Planck-Institut für Aeronomie, Lindau über Northeim (W. Germany).

BALLOON INSTRUMENT MEASUREMENT OF X-RAY AND SOLAR PROTONS IN THE NORTHERN AURORAL ZONE [MESSUNG VON RONTGENSTRAHLUNG UND SOLAREN PROTONEN MIT BALLONGERATEN IN DER NORDLICHTZONE]

Erhard Keppler Berlin, Springer-Verlag, 1964 51 p refs In GERMAN *Its* Mitt. Nr. 15

Two strong solar flares were observed and measured by balloon instrumentation between July 11 and 16, 1961, at heights of 30 to 40 km over Kiruna (Sweden). Measured were solar protons and solar-proton-induced nuclear gamma-rays and X-rays. Four hours before the sudden commencement of the geomagnetic turbulences, an increased proton flow of about 100 keV was detected that culminated in a sudden peak at the moment of solar eruption. The data were compared with observations from various stations on the North American continent and showed a widespread distribution of low-energy solar protons. These protons caused nuclear gamma radiation in the atmosphere. G.G.

N65-14234# Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.

STATISTICAL INVESTIGATION OF THE RELATIONSHIPS BETWEEN SOLAR RADIO BURSTS AND OTHER FLARE-COMPLEX PHENOMENA DURING IGY

A. Krüger 22 Jul. 1964 24 p refs Transl. into ENGLISH from Astron. Nachr. (Kiel), v. 287, no. 3, Jul 1963 p 119-129 APL Library Bull. Transl. Ser.

(Contract NOw-62-0604-c)

(TG-230-T441; AD-448104)

The relationship between the number of solar radio bursts and some other phenomena of solar activity was investigated statistically by means of observations made during the IGY. Close correlations were verified between burst in the cm- and lower dm-range and flares, and between sudden ionospheric disturbances (SID) and bursts, respectively. The total energy emitted in the cm-range can be regarded as a criterion for the simultaneous appearance of SID's and bursts. The behavior of bursts in the m-range and of geomagnetic solar flare effects was examined. The frequency of occurrence of bursts as a function of sunspot numbers was analyzed and was compared with the slowly varying component of solar radio emission. The positions of flare centers on the sun were taken into consideration. Author

N65-14315# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
CYCLOTRON INSTABILITIES AND ELECTROMAGNETIC EMISSION IN THE ULF AND VLF RANGES
J. M. Cornwall 15 Sep. 1964 30 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-161; TDR-469(5260-20)-1; AD-451484)

A model for the generation of pearl-type micropulsations in the 0.1- to 5-cps range is presented. Under a different set of conditions, the model is also applicable to the generation of vlf emissions in the whistler mode. It is proposed that a beam of trapped protons at $L \leq 4$, supersonic with respect to the local Alfvén speed, emits hydromagnetic waves at a frequency corresponding to the occurrence of a cylcotron instability. These hydromagnetic waves propagate along the earth's field lines, and are reflected back along the line at the ionosphere. On each pass of a wave packet through the proton beam, energy is supplied to the wave by the particles via the instability. Certain features of the observed fine structure of micropulsations are explained with the concept of bouncing hydromagnetic wave packets. A possible candidate for the necessary proton beam is the belt of 200- to 500-keV protons observed by Davis and Williamson, but there are other candidates as well, including low-energy ring currents at $L \simeq 6$. Vlf emission in the 1- to 10-kc range may be produced by a similar instability if a beam of energetic electrons is present. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-13359# Queens U., Belfast (Northern Ireland).
IMPACT IONIZATION CROSS SECTIONS
In its Res. on Phys. of The Upper Atmosphere 30 Jun. 1964 p 31–37 refs (See N65-13351 04-34)

The interpretation of the solar corona spectrum depends, among other things, on a detailed knowledge of ionization cross sections by electron impact. Recent calculations indicate that a good estimate of these cross sections may be obtained by a scaling procedure. Further calculations of ionization cross sections are presented for Fe^{XVI} and the whole Na^{I} isoelectronic sequence. D.S.G.

N65-13418 System Development Corp., Lexington, Mass.
ORBITAL ANALYST HANDBOOK
R. E. Ferguson 4 May 1964 379 p
(Contract AF19(628)-1648)
(TM-LX-123/000/00; AD-607319) OTS: $8.10

Detailed procedures and standardized methods are provided for such satellite processing tasks as domestic launch, foreign launch, debris separation, proximity determination, element maintenance, and decay prediction. A check list is provided for each problem, and required steps leading to its solution are identified. Analyst procedures are described and cross referenced to pertinent tasks. Supporting computer programs are organized by functional area with respect to their use, input options and formats, and output format. Appended are forms, charts, and graphs of conversion factors, modified Julian days, oblate spheroidal earth model, satellite elevation and slant range, semimajor axis vs period, mathematical constants, formulas, etc. R.L.K.

N65-13517# Oklahoma U., Norman.
A STUDY OF ATMOSPHERIC RE-ENTRY TRAJECTORIES WITH SPECIAL CONSIDERATION OF DRAG IN THE TRANSITION AND SLIP REGIMES
Robert D. Loukota (M.S. Thesis) 1964 91 p refs
(AD-603480) OTS: $4.00

Drag on reentry bodies in the transition and slip flow regimes is discussed with emphasis on the coefficient of drag and its effect on reentry trajectories. The work is divided into two major areas: (1) derivation of the equations of motion for a reentry vehicle and development of a computer program which will solve these equations, and (2) analysis of two computer solutions for each of several reentry configurations and initial conditions. A comparison of the two solutions indicates the importance of considering a correlation equation, such as the Martino equation, in some trajectory calculations for bodies with small W/A ratios. D.E.W.

N65-13519# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
NORMAL SHOCK PARAMETERS FOR THE VENUSIAN ATMOSPHERE
F. Bosworth, C. Cook, L. Gilbert, and S. Scala Dec. 1964 60 p refs
(R64SD65)

Normal shock wave and stagnation point solutions for four Venusian atmospheric and chemical models are presented which cover a range of flight speeds from 10 000 to 40 000 fps, and a range of altitudes from 50 000 to 430 000 ft. Singly ionized chemical species are included in the analysis and in the numerical solution of the thermochemical equations. Curves of dimensionless pressure, temperature, and density of the shocked gas are presented as functions of flight speed for constant altitudes. Author

N65-13527*# National Aeronautics and Space Administration, Washington, D.C.
SPACE EXPLORATION—THE CHALLENGE AND THE PROMISE NASA News Release
James E. Webb 21 Dec. 1964 25 p Address Presented to Commercial Club of Chicago, 21 Dec. 1964 Available from the Scientific and Technical Division

According to James E. Webb, the Mariner IV spacecraft epitomizes the combination of government, universities, and industry that is bringing the vastness of space within the reach of the nation. The reasons for the exploration and use of space are reviewed, and recent achievements in the space program are mentioned. The overall space program and its many implications for life in the U.S. and throughout the world are discussed. D.E.W.

N65-13536*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
SPACE ENVIRONMENT CRITERIA GUIDELINES FOR USE IN SPACE VEHICLE DEVELOPMENT
Robert E. Smith, ed. 30 Sep. 1964 88 p refs
(NASA-TM-X-53142) OTS: HC $3.00/MF $0.75

This report establishes design guideline values for the following environment parameters: (1) meteoroids, (2) secondary ejecta, (3) radiation, (4) gas properties, (5) magnetic fields, (6) solar radio noise, (7) winds, (8) wind shear (9) clouds, (10) ionosphere, (11) albedo, (12) planetary surface

conditions, (13) planetary satellites, (14) composition of the planetary atmospheres, (15) temperature, and (16) astrodynamic constants. Author

N65-13541*# Consultants and Designers, Inc., Arlington, Va.
SIZE DISTRIBUTION OF COSMIC BALLS ORIGINATING FROM THE REGION OF THE TUNGUSKA METEORITE FALL [RASPREDELENIYE PO RAZMERAM KOSMICHESKIKH SHARIKOV IZ RAYONA TUNGUSSKOGO PADENIYA]
N. I. Zaslavskaya, I. T. Zotkin, and O. A. Kirova 15 Jun. 1964 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Astron. (Moscow), v. 156, no. 1, 1 May 1964 p 47–49
(Contract NAS5-2078)
(NASA-TT-F-8909; ST-ID-10155) OTS: HC $1.00/MF $0.50

An investigation of the soil in the region of the fall of the Tunguska meteorite to isolate particles of cosmic origin is reported. The methods of soil sampling and sample treatment are described, and a low-power photomicrograph of meteoritic magnetite spherules is included. The geographic distribution of the spherules around the epicenter of the impact is described, and the diameters are graphed vs the masses of the magnetite balls. An exponential distribution was found for this relationship having an exponent of 1.2. This value is compared with those of exponents derived from other types of experiments, such as sounding rocket sampling of the upper air, impact registrations on satellites, aerosol collections, radar detections, and visual sightings. It is concluded that the Tunguska meteorite was a nucleus of a small comet that underwent an explosive disintegration while moving in the atmosphere at a height of the order of 10 km. D.E.W.

N65-13553*# Consultants and Designers, Inc., Arlington, Va.
ANALYTICAL METHODS OF DETERMINING THE PERTURBATIONS OF HYPERBOLIC ELEMENTS [ANALITICHESKIYE METODY OPREDELENIYA VOSMUSHCHENIY GIPERBOLICHESKIKH ELEMENTOV]
Kh. Kh. Akhmad 16 Dec. 1964 17 p Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 3, Fiz. Astron. (Moscow), no. 5, 1964 p 15–27
(Contract NAS5-3760)
(NASA-TT-F-9611; ST-CM-10260) OTS: HC $1.00/MF $0.50

A formula is presented that defines the first-order perturbation of hyperbolic elements for both the intrinsic and extrinsic variants; the intrinsic form with a precision to the third degree of the ratio of the semiaxes, and the extrinsic form with a precision to the second degree of the ratio of the semiaxes. However, since the perturbed body in the vicinity of the perturbing body undergoes strong variations, a complete investigation of the first body variations was made by the application of the Laplace method. As an example Jupiter is viewed as the principal body, and the Sun as the perturbing one. It is shown that, by certain changes in the formulas determining the perturbations of heliocentric elements, formulas providing the perturbations of jovicentric elements can be obtained. G.G.

N65-13616# North American Aviation, Inc., Downey, Calif. Space Sciences Lab.
NARROW-BAND PHOTOMETRY OF STARS, PLANETS AND SATELLITES
D. H. Mc Namara 23 Jan. 1964 75 p refs
(Contract Nonr-3979(00))
(SID-64-78; AD-430060)

Photometry in the c-1 system of stars in the galactic cluster NGC 752 is described. Intrinsic B–V colors and absolute magnitudes of individual stars are derived from the photometry. A reddening of $E(B-V) = +0.085$ and an ultraviolet excess of $\delta(U-B) = -0.10$ are derived from the observations. All stars including even the faintest in the cluster are found to lie above the zero age main sequence. The true distance modulus of the cluster is found to be $8^{m}.4$. Author

N65-13784*# Interior Dept., Washington, D.C. United States Geological Survey
ASTROGEOLOGIC STUDIES, SUMMARY Annual Progress Report, Aug. 25, 1962–Jul. 1, 1963
Jun. 1964 52 p
(NASA Order R-66)
(NASA-CR-59125) OTS: HC $3.00/MF $0.50

Summaries of studies on lunar and planetary investigations, crater and solid state investigations, cosmochemistry and petrography, and studies for the space flight program are presented. The studies are reported fully in other volumes of the annual report. R.L.K.

N65-13795# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
THE TOTAL LUNAR ECLIPSE OF DECEMBER 30, 1963; OBSERVATIONS AT 3.2 MILLIMETERS
E. E. Epstein, E. Jacobs, H. E. King, E. E. Reber, F. I. Shimabukuro et al 19 Oct. 1964 37 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-240; TDR-269 (4250-41)-4; AD-451758)

A description is presented of the instrumentation, the observing procedures, and the measured results of the total lunar eclipse of December 30, 1963. Radiometric measurements were conducted at an operating wavelength of 3.2 mm (94 Gc) with a high-resolution antenna. Specific areas of the lunar surface were monitored during the eclipse. A summary of the relative temperatures and the cooling rates of the observed areas is included. Author

N65-13802# Naval Research Lab., Washington, D.C. Atmosphere and Astrophysics Div.
THE MEAN DISTANCE TO THE MOON AS DETERMINED BY RADAR Interim Research Report
B. S. Yaplee, S. H. Knowles, A. Shapiro, K. J. Craig, and D. Brouwer, (Yale U. Obs.) 16 Sep. 1964 13 p refs
(NRL-6134; AD-607354) OTS: $0.50

The distance to the moon was measured by radar with a basic resolution of ±150 m. The measured distance from the observing station to the nearest point of the moon was corrected for the earth's rotation and the motion of the moon. In addition, the libration of the moon changes the nearest point of reflection with time. As observations were made over many months, several returns from the same lunar area were obtained. The monthly variations in distance due to lunar topography were used to derive an equivalent radar topographical map around the central region of the moon. This map provided the necessary corrections to account for lunar topographical variations. All the measured distances after applying the above corrections were used in a least square solution with the best known constants. The solution yielded a value of 384 400 km ±1.2 km for the mean distance to the moon. Author

N65-13869*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METEORIC FLUX AND DENSITY FIELDS ABOUT A FINITE ATTRACTIVE CENTER GENERATED BY A STREAM MONOENERGETIC AND MONODIRECTIONAL AT INFINITY
D. P. Hale and J. J. Wright Washington, NASA, Jan. 1965 26p refs
(NASA-TN-D-2573) OTS: HC $2.00/MF $0.50

Detailed meteoric flux and particle density field patterns generated by a meteoric stream, monodirectional and monoenergetic at infinity, and incident upon a finite attractive center are derived and exhibited. Flux and density contours are obtained for a series of incident speeds spanning the entire range of established meteoric stream velocities. The development reveals the existence of five sectors about the attractive center. In some, flux is unscattered; in others, the flux is scattered; in one, the flux is both unscattered and scattered; in another, the null cone, there is no flux. All sectors including the null cone were treated in detail. An explicit theoretical explanation of abrupt discontinuities in flux and enhanced particulate concentrations near the earth, both of which are observed in rocket and satellite experiments, is given. Author

N65-13870*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METEORIC FLUX AND DENSITY FIELDS ABOUT AN INFINITESIMAL ATTRACTIVE CENTER GENERATED BY A STREAM MONOENERGETIC AND MONODIRECTIONAL AT INFINITY
D. P. Hale and J. J. Wright Washington, NASA, Jan. 1965 22p refs
(NASA-TN-D-2574) OTS: HC $1.00/MF $0.50

The meteoric field structure theory, previously developed for meteoric streams monoenergetic and monodirectional at infinity, is applied to the problem of a meteoric stream incident upon an infinitesimal attractive center. Flux and density contours about the center are explicitly obtained for a particle speed at infinity of 2 km/sec as an example of a method developed to provide flux and density contours for any speed. An incident stream 5 to 10 earth diameters in width results in an order of magnitude enhancement of flux at points downstream from the attractive center. The flux patterns for any energy can be derived from a universal flux plot in terms of a dimensionless parameter $\lambda = y\,r$ where $y = \frac{V_\infty^2}{\gamma M}$ and r is distance in earth (or center) radii. This universal flux plot is exhibited in the paper. Author

N65-13871*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOME ASPECTS OF THE DISTRIBUTION OF METEORIC FLUX ABOUT AN ATTRACTIVE CENTER
R. D. Shelton, H. E. Stern, and D. P. Hale Washington, NASA, Jan. 1965 59 p
(NASA-TN-D-2575) OTS: HC $3.00/MF $0.75

The discussion is in the form of a general survey to illustrate the magnitude and nature of some of the problems associated with measuring meteoroid flux from moving satellites. The application of the Liouville theorem represents an extension of a practice common to the treatment of charged particles in electromagnetic fields, and the treatment of the structure of the flux field constitutes an extension of the asymptotic discussion of the Rutherford scattering problem involving Coulomb repulsion to the region near an attracting force center. The problem of the orientation of a nonspherical detector is not considered. The techniques developed are applied to the detailed interpretation of the count rate measured by the Saturn boosted micrometeoroid satellite. A mathematical basis for discussing such subjects as the focusing of meteoroids by the earth is provided. Author

N65-14034# Harvard Coll. Observatory, Cambridge, Mass.
THE SUN'S MAGNETIC FIELD AND THE STABILITY OF SOLAR MARKINGS Scientific Report No. 24
Donald H. Menzel and G. E. Moreton Nov. 1963 18 p refs
(Contract AF 19(604)-4962)
(AFCRL-63-762; AD-427381)

This paper relates to the interpretation of solar observatory photographs taken with an Hα filter having a pass band of 0.5 Å, and is concerned particularly with the relatively permanent reseau characteristically present in the off-band photographs. Photographs taken at the line center refer to higher atmospheric levels than do those taken in the wings. The program of solar photography has featured the taking of records in rapid sequence at 10 sec intervals. Records taken approximately 0.5 Å to the red or violet of the line center are relatively free from the complex bright and dark plages characteristic of chromospheric and prominence activity. Author

N65-14044# Air Force Cambridge Research Labs., Bedford, Mass.
THE NATURAL ENVIRONMENT FOR THE MANNED ORBITING LABORATORY SYSTEM PROGRAM (MOL) Special Reports No. 7
25 Oct. 1964 49 p refs
(AFCRL-64-845; AD-607725)

The natural environment of the Manned Orbiting Laboratory (MOL) in a near-earth orbit is described. Parametric information based primarily on material from the forthcoming Handbook of Geophysics and Space Environments is provided on the upper atmosphere, the geomagnetic field, corpuscular radiation, meteoroids, and the sun. A selected bibliography on these subjects is provided as a guide to sources of more detailed information. Author

N65-14046# High Altitude Observatory, Boulder, Colo.
REPORT ON SOME SOLAR RESEARCH AND INSTRUMENTATION PROGRAMS AT SACRAMENTO PEAK OBSERVATORY AND HIGH ALTITUDE OBSERVATORY Final Report, 1 Apr. 1960–30 Jun. 1964
John W. Firor and Robert L. Shutt 28 Sep. 1964 21 p refs
Prepared jointly with Sacramento Peak Obs.
(Contract AF 19(604)-6664)
(AFCRL-64-857; AD-608700)

Instrumentation currently under development at the observatory includes (1) two spectrographs using the 10-cm solar images generated by the 16-inch coronagraph and the coelostat telescopes, covering the spectral range λ3200 to λ12 000; (2) a recording doppler comparator to measure velocity shifts of solar spectral lines; (3) a modified 16-inch coronagraph; (4) a low-level light photometer system; and (4) a 6-inch white light patrol camera and telescope system to monitor solar disk phenomena. Of the several solar research programs described, emphasis is given to the observations of the total solar eclipse at Lae, New Guinea, on 5 February 1962. D.S.G.

N65-14116*# Michigan U., Ann Arbor.
HODOGRAPH ANALYSIS OF THE FREE-FLIGHT TRAJECTORIES BETWEEN TWO ARBITRARY TERMINAL POINTS
Fang Toh Sun Washington, NASA, Jan. 1965 76 p refs
(Grant NsG-558)
(NASA-CR-153) OTS: HC $3.00/MF $0.75

An analytic treatment of the free-flight trajectories between two terminal points in space, using the hodograph method, is presented. A general case is assumed in which the range angle

and the terminal distances from the field center are both arbitrary, and all three possible types of the Keplerian trajectories, the elliptic, the parabolic, and the hyperbolic, are considered. A single representation of the infinitely many such trajectories in a dimensionless hodograph plane is introduced, and a general survey of such trajectory systems as seen from the hodograph is made. By using the hodograph geometry the characteristics of the conjugate trajectories are explored; and in line with this the minimum energy trajectory is briefly reviewed. Also, the existence of a least eccentric trajectory for given terminal points is proved, and its characteristics are briefly analyzed. Author

N65-14117*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THEORETICAL MODEL ATMOSPHERES OF VENUS
Robert B. Owen Washington, NASA, Jan. 1965 46 p refs
(NASA-TN-D-2527) OTS: HC $2.00/MF $0.50

From a survey of past and present literature, a summation of various models of the atmosphere of Venus is presented. It is shown how these models were formed and eliminated; and a final model, apparently more consistent with recent observations, is advocated. This model, one of the greenhouse variety, indicates more extreme surface conditions than were previously suspected. Author

N65-14187# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
A PRELIMINARY INVESTIGATION OF THE USE OF INERTIAL GUIDANCE FOR CO-PLANAR ORBITAL RENDEZVOUS
Donald B. Darby (M.S. Thesis) Aug. 1964 137 p refs
(GA/EE/64-3; AD-607118)

This thesis is a preliminary investigation of the use of inertial guidance to control the transfer-orbit injection phase of an orbital rendezvous. Assumptions are made to narrow the problem to a rendezvous between elliptical coplanar orbits about a spherical body, with the vehicle being transferred reacting as a point mass. The theory of the guidance equations is given, and the method used to solve them is explained fully. A digital computer program simulates the operation of the guidance system and the flight of the space vehicle during both the guidance phase and the coasting phase. With the program three representative cases of rendezvous are investigated: (1) between widely separated circular orbits; (2) between nonalined highly eccentric orbits; and (3) between slightly eccentric nonalined low earth orbits. Author

N65-14286# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPLOSIONS ON THE SUN
V. Krat 21 Sep. 1964 7 p Transl. into ENGLISH from Izvestia (Moscow), no. 10, 1962 p 4
(FTD-TT-64-408/1; AD-607140) OTS: $1.00

The work of A. Severnyy on chromospheric flares is reviewed. Some of the phenomena he observed in conjunction with chromospheric flares were: magnetic storms; illumination in the spectral lines of hydrogen, ionized calcium, and sometimes helium; and illumination in a continuous spectrum. The last phenomenon comes from electrons moving at the speed of light. When moving in a magnetic field, part of their energy is converted into illumination. Severnyy postulates that the flares are electrical plasmas whose behavior depends on the character of the magnetic field. In the complicated magnetic field of a group of sunspots, the plasma is unstable and spontaneously compresses. This compression in the surrounding gas induces shock waves. The waves create condensations of the gas which are the chromospheric flares. E.K.R.

N65-14298*# Consultants and Designers, Inc., Arlington, Va.
ESTIMATE OF THE MASS OF A SUPERNOVA [OTSENKA MASSY SVERKHZVEZDY]
Ya. B. Zel'dovich and I. D. Novikov 7 Dec. 1964 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Astron. (Moscow), v. 158, no. 4, 1964 p 811–814
(Contract NAS5-3760)
(NASA-TT-F-9605; ST-SA-10254) OTS: HC $1.00/MF $0.50

The assumption that the radial pressure of a supernova is equilibrated by the gravitational force leads to the estimate of supernova nucleus mass at $\approx 10^{8} M_{\odot}$. In the outer parts of the atmosphere, where the light pressure upon matter is mainly determined by photoionization processes rather than by scattering over electrons, the radiation forces increase sharply, the equilibrium is disrupted, and the outer parts of the atmosphere are ejected. A possible generation mechanism of supernova energy is the accretion of atmospheric matter in the close environment of the collapsing nucleus. The quantity of falling matter required for ensuring the observed light flux is $\approx 3 M_{\odot}$/year. This mechanism is self regulating. Author

N65-14388# Texas U., Austin. Electrical Engineering Research Lab.
AN INVESTIGATION OF TAU A AND SGR A MILLIMETER WAVELENGTH RADIATION Scientific Report No. 2
C. W. Tolbert and A. W. Straiton Bedford, Mass., AFCRL, 28 Aug. 1964 18 p refs *Its* Rept.-6-61
(Contract AF 19(628)-1679)
(AFCRL-64-720; AD-607559)

The technique of investigating the position and flux density of 35 Gc and 70 Gc Tau A radiation and 35 Gc Sgr A radiation are described. Tau A (35 Gc) and Sgr A (35 Gc) flux densities were $420 \pm 60 \times 10^{-26}$ Wb/m^2/cps and $290 \pm 100 \times 10^{-26}$ Wb/m^2/cps, respectively. The flux density of Tau A (70 Gc) interpreted from an antenna temperature signal-to-noise ratio of approximately 2 to 1 was $790 \pm 450 \times 10^{-26}$ Wb/m^2/cps. Observations of 94 Gc of Sgr A, having a calculated antenna temperature standard deviation of 0.2° C, revealed no source of radiation at the central position of Sgr A (35 Gc). The 35 Gc position of Tau A and Sgr A coincided, within the limits of the measuring accuracy $\pm 3^{s}$ R. A. and $\pm 1'$ Dec., with lower frequency source positions. Author

N65-14417# Royal Aircraft Establishment, Farnborough (Gt. Brit.)
DERIVATIVES AT INJECTION INTO ORBIT AS FUNCTIONS OF ECCENTRIC ANOMALY
R. Law Jul. 1964 37 p refs
(RAE-TM-SPACE-40)

An earlier note treated the effects of injection errors on a satellite orbit by means of first-order partial derivatives; these were expressed as functions of true anomaly. However, it is sometimes more convenient to express them as functions of eccentric anomaly and they are given here in that form. The first-order partial derivatives of the eccentric and mean anomalies at injection are derived. Numerical results for these derivatives are for the same family of orbits illustrated in the previous note, and are given in dimensionless form. Conversion to dimensional form, for particular values of the earth constants, is also illustrated. Author

N65-14426*# Consultants and Designers, Inc., Arlington, Va.
ON POSSIBLE MECHANICAL PHENOMENA AT MOTION OF METEOR BODIES [O VOZMOZHNYKH MEKHANICHESKIKH YAVLENIYAKH PRI DVIZHENII METEORNYKH TEL]
G. I. Pokrovskiy 1 Dec. 1964 13 p Transl. into ENGLISH from Meteoritika (Moscow), v. 20 p 95–102
(Contract NAS5-3760)
(NASA-TT-F-9602; ST-IM-10252) OTS: HC $1.00/MF $0.50

It is postulated and analyzed mathematically that the forces generated by a disintegrating meteor traveling at high speed in the earth's atmosphere are complex and are not all necessarily opposed to the forward motion of the meteorite. Some of the forces, in fact, tend to accelerate the meteorite and, consequently, to increase the ultimate energy released on impact or explosion. A laboratory experiment designed to test these postulates gave results in agreement with phenomena observed with the Tunguska (U.S.S.R.) meteorite fall. E.K.R.

N65-14461# Aerospace Corp., El Segundo, Calif. Computation and Data Processing Center
TRACE—AEROSPACE ORBIT DETERMINATION PROGRAM
R. J. Mercer et al Nov. 1964 227 p refs
(Contract AF 04(695)-269)
(TDR-269(4110-04)-1; SSD-TDR-64-159; AD-454404)

TRACE is a multiple-purpose satellite orbit-determination program for the IBM 7090 computer. Its applications include: (1) prediction—the generation of a satellite trajectory and associated ground trace and station sighting data; (2) orbit determination—the estimation of trajectory parameters, station locations, and observational biases, so as to best fit a set of observations; and (3) error analysis—the estimation of the potential accuracy attainable by a tracking system, given the station locations, the data types, rates and quality, the uncertainties in the model parameters, and the specifications of the nominal orbit. The report contains the objectives of the program, some theoretical foundations, the equations and methods employed, the structure of the program, and complete instructions for its use. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-13564*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
SUMMARY OF MAJOR NASA AMR (ETR) LAUNCHINGS 1 October 1958–30 September 1964 KSC Historical Report No. 1
Nov. 1964 24 p
(NASA-TM-X-54898) OTS: HC $1.00/MF $0.50

Specific major Atlantic Missile Range launchings are classified under the following headings: scientific satellites, meteorological satellites, communications satellites, scientific lunar probes, scientific deep space and planetary probes, launch vehicles, Project Mercury, Project Gemini, and Project Fire. Categorized mission results, launch vehicle, launch date, and remarks are included in the report. E.C.

N65-13883# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
STATIC AERODYNAMIC STABILITY CHARACTERISTICS OF A TWO STAGE TANDEM WINGED RECOVERABLE LAUNCH VEHICLE (ASTRO) AT SUBSONIC AND SUPERSONIC MACH NUMBERS. VOLUME I: MODEL BUILD UP, BOOK III
May 1964 289 p
(SM-47628)

Graphs are presented of yawing moment coefficient and side force coefficient vs total angle of attack; of axial force coefficient vs total angle of attack; and of rolling moment coefficient vs total angle of attack. D.E.W.

N65-13963*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC INVESTIGATION OF A SPINNING AND NONSPINNING MODEL OF A CAJUN (OR APACHE) ROCKET VEHICLE WITH ROLL-CONTROL TABS
Ralph A. Falanga Washington, NASA, Jan. 1965 45 p refs
(NASA-TN-D-2576) OTS: HC $2.00/MF $0.50

A model of the Cajun rocket with nose cone and standard fin assembly (scaled to 0.401) was tested in a wind tunnel from Mach 2.30 to 4.63 at a Reynolds number of 2.5×10^6 per foot. Some additional data are presented for Reynolds number of 4.0×10^6 per foot and for model incidence angles other than zero. Measured wind-tunnel results on 11 roll-control-tab configurations (plates with wedge-shaped cross section) for mounting on the trailing edge of the stabilizing fins of Cajun stage to obtain roll-effectiveness data are presented, along with the general aerodynamic characteristics defining this vehicle. The data obtained for the total rolling-moment coefficient and the damping-in-roll derivative compared favorably with theoretical results. Author

N65-13987# Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
GRAVITY-GRADIENT ATTITUDE STABILIZATION FOR COMMUNICATION SATELLITES
Frederick F. Mobley Sep. 1964 51 p refs
(Contract NOw-62-0604-c)
(TG-597; AD-608968)

Gravity-gradient attitude stabilization was used successfully in a number of near-earth satellites in recent months. The first successful demonstration of gravity stabilization in June 1963 has become one of the basic elements of satellite technology. By January of 1964 three satellites had been vertically stabilized by the passive gravity-gradient technique, and are expected to continue in this state indefinitely. These developments are reviewed herein, and the problems of extending these techniques to higher altitude for use as communication satellites are discussed. Author

N65-14133# Library of Congress, Washington, D.C. Aerospace Technology Div.
MATERIALS ON VOSTOK-5, VOSTOK-6, AND POLET-1 FLIGHTS Surveys of Soviet-Block Scientific and Technical Literature
16 Oct. 1964 70 p refs
(ATD-P-64-57; AD-607772)

The main purpose of the two joint flights of the Vostok spaceships, the launching of the Polet-1 maneuverable vehicle, and the launchings of the Cosmos satellites are connected with the development of heavy Soviet space vehicles, including large orbiting stations. The components of the life-support systems for future heavy space vehicles were tested

during the joint flights of the Vostok spaceships. The Cosmos satellites tested design elements for protection against radiation and meteorite hazards. These satellites played an important role in the development of the Polet-1 maneuverable vehicle. The Polet-1 should be considered the first vehicle on which the elements of a maneuver system for a lunar flight vehicle were tested in space. Author

N65-14165# Joint Publications Research Service, Washington, D.C.
USE OF ARTIFICIAL EARTH SATELLITES FOR GEODETIC PURPOSES
Yu. M. Fershtman 8 Jan. 1965 18 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 11, 1964 p 67–77 (JPRS-28204; TT-65-30096) OTS: $1.00

Satellites can be used for solving principal problems in geodesy by the dynamic method involving observations of anomalies of motion of the satellite for determining more precisely the parameters of the earth's gravity field, or by the geometric method involving sighting of the satellite from ground stations and establishing the basis for a triangulation system. Both methods are described, and the applications to the program of observations of the geodetic satellite ANNA-1B are discussed. Optical and radiometric observation procedures and equipment are given, and the determination of the coefficients for even zonal harmonics is described. D.S.G.

N65-14171# Pratt and Whitney Aircraft, West Palm Beach, Fla.
ENGINE COST AND RELIABILITY CONSIDERATIONS FOR REUSABLE LAUNCH VEHICLES
Robert R. Atherton and Martin Pike 10 Nov. 1964 23 p
(PWA-FR-1191)

For a vehicle requiring a million and a half pounds of thrust and a flight program of 2000 launches over a 10-year period, it was found that the total program costs chargeable to propulsion decreased significantly if the engine development program is continued well beyond PFRT, because of the improved level of engine reliability so obtained. The number of engines used to provide the total thrust required was found to have little effect on program cost in the range of four to ten engines (150 000 lb to 375 000 lb thrust per engine). Major variations for flight operations cost, vehicle cost, and vehicle overhaul cost had little effect on the conclusion as to the extent of engine development for minimum propulsion cost. As the number of flights in the launch program was increased, significantly more engine development was found necessary to obtain the lowest overall propulsion costs. Author

N65-14395*# General Dynamics/Astronautics, San Diego, Calif.
PROJECT FIRE INTEGRATED POST FLIGHT EVALUATION REPORT, FLIGHT NO. 1
30 Oct. 1964 181 p Supported by NASA
(Proj. FIRE)
(NASA-CR-57017; GDA/BKF-64-018) OTS: HC $5.00/MF $1.25

The flight of the first Project Fire space vehicle, on April 14, 1964, is reported. Its purpose was to obtain data on convective and radiative heating, radio signal attenuation, and material behavior during reentry into the earth's atmosphere at a velocity near 37 000 fps. The space vehicle consisted of an Atlas launch vehicle, a velocity package containing an Antares II A5 rocket motor, and a reentry package. The Atlas injected the Fire spacecraft into a precise ballistic trajectory along the AMR. Upon Atlas separation the spacecraft was oriented to the proper attitude for ignition of the Antares rocket which was ignited at a predetermined time. This accelerated the reentry package to 37 972 fps for reentry into the earth's atmosphere, 4335 n.m. downrange near Ascension Island. A unique composite heat shield, consisting of two jettisonable phenolic asbestos layers sandwiched between three beryllium calorimeters, was used on the reentry package to provide three measurement periods during the heat pulse. All flight events occurred as planned and within allowable time limits, and the reentry performance was excellent. A detailed discussion of all aspects of the mission is given. D.E.W.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-13437# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TECHNOLOGY OF SUBMERSION AND INJECTION OF A CYLINDRICAL REINFORCED CONCRETE PILING
B. P. Konstantinov 30 Dec. 1963 9 p Transl. into ENGLISH from Transportnoe Stroit. (USSR), no. 10, 1962 p 46–48 (FTD-MT-63-127; AD-605896)

The following methods of submersing cylindrical reinforced concrete pilings in sand were evaluated: washing with air-pressure needles, use of vibration sinkers, and use of vibration sinkers coupled with washing and airlifting. An inspection of the experimental rabbets, unearthed at a depth of 7.3 m, established that their locks did not receive any damages. A cement–sand solution of 1:1 composition at a water–cement ratio of 0.48 was selected as very efficient for the filling of lock cavities under water. The feeding slot should be limited to 5 mm to exclude any invasion by water. G.G.

N65-13514# Brown U., Providence, R.I.
TIME AND DISPLACEMENT BOUND THEOREMS FOR VISCOUS AND RIGID-VISCO-PLASTIC CONTINUA SUBJECTED TO IMPULSIVE LOADING
J. B. Martin Aug. 1964 33 p refs
(Contract N189(181)-57827A(X))
(BU/DTMB/4; AD-606960)

Earlier work that developed a method of computing deformation time and final displacement bounds for rigid-plastic structures and continua subjected to impulsive loading is extended to cover all materials in which stress and strain rate are related in a reversible manner. Particular emphasis is given to rigid-viscoplastic materials, and examples are presented. Author

N65-13552*# Consultants and Designers, Inc., Arlington, Va.
THE INTERACTION OF A BODY AND A SEMI-INFINITE OBSTACLE AT VERY HIGH VELOCITIES OF IMPACT [VZAIMODEYSTVIYE BOYKA I POLUBESKONECHNOY PREGRADY PRI BOL'SHIKH SKOROSTYAKH SOUDARENIYA]

A. Ya. Sagomonyan 3 Dec. 1964 16 p Transl. into ENGLISH from Vestn. Mosk. Univ., Ser.I. Mat. I Mekhan. (Moscow), no. 5, 1964 p 39–48
(Contract NAS5-3760)
(NASA-TT-F-9603; ST-HD-10253) OTS: HC $1.00/MF $0.50

A simplified scheme is considered for the interaction phenomenon between a body of small mass and a fixed semi-infinite obstacle, attended by the formation of shock waves. The velocity of the contact surface relative to the obstacle and the velocity of the striking body relative to the contact surface are assumed to be supersonic. The material behind the shock waves is simulated by an incompressible fluid. The positions of the forepart of the contact surface and of the shock wave are determined approximately at completion of interaction. Author

N65-13580# Polytechnic Inst. of Brooklyn, N.Y.
AXISYMMETRIC, PLANE-STRAIN DYNAMIC RESPONSE OF A THICK, ORTHOTROPIC, VISCOELASTIC SHELL
Jerome M. Klosner and Clive L. Dym *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 55–73 refs (See N65-13577 04-34)
(Contract Nonr-839(32)(FBM); NSF GP-1246)
(32)

The plane-strain, axisymmetric, thickness-stretch modes of a thick, orthotropic, viscoelastic shell embedded in a thin elastic casing are investigated. The steady-state dynamic response of the orthotropic, viscoelastic shell is obtained and compared with the response of the elastic shell. A higher order shell theory is developed, and its accuracy for the lower modes is demonstrated. The effect of orthotropy on the rapidity of the transition from the free vibrations of a plate to that of a solid, elastic, circular cylinder is investigated. Author

N65-13582 Rocketdyne, Canoga Park, Calif.
FIBER MECHANICS OF REINFORCED STRUCTURES
Robert S. Goldberg and Hugh N. Chu *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 91–102 refs (See N65-13577 04-34)
(Contract Nonr-3858(00))

A new method has been developed for studying stress transfer in reinforced solid propellants. Specially prepared photoelastic models are used to observe and study the origin and transfer of stresses in a complex reinforced structure. The utility of reinforced photoelastic models has been shown by actual use to be a powerful tool for measuring so-called "internal strain" in anisotropic, nonhomogeneous structures. Initial experiments revealed unexpected phenomena which appear to be of fundamental significance in understanding the mechanics of fiber-reinforced materials. A mathematical model to explain the origin of internal strain forces in reinforced composites is in good agreement with the experimental photoelastic models. The importance of this research effort is that failure mechanisms and criteria may be investigated by quantitative measurement with simulated failure models. Author

N65-13585 Aerojet-General Corp., Sacramento, Calif.
SOLUTION OF THE AXISYMMETRIC, VARIABLE PROPERTY, ELASTICITY EQUATIONS BY MEANS OF STRESS FUNCTIONS
Leonard R. Herrmann *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 131–140 refs (See N65-13577 04-34)

The axisymmetric elastic field equations for a body possessing variable material properties are solved by means of a pair of stress functions. The stress functions are so selected that, for the special case of constant material properties, they are identical to the Southwell stress functions. Author

N65-13588 Stanford U., Calif.
STRESS ANALYSIS FOR NON-LINEAR VISCO-ELASTIC BODIES
E. J. Appleby and E. H. Lee *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 169–175 refs (See N65-13577 04-34)
(Contract Nonr-225(69))

Most of the applications of nonlinear viscoelastic theory use analytically simple approximations to the functionals which appear, and are based on an expansion about a condition of steady deformation. This is not an appropriate approach for the pressurization problem in which pressure is applied rapidly from the undisturbed state, reaching a peak and then decreasing, and maximum stresses are likely to occur during the pressure pulse. Evaluation of the multiple integrals representing the nonlinear functionals is carried out from the time of initial loading. A convenient form for numerical evaluation is achieved, and an elementary example is solved. Use of this representation to determine the material functions which appear as kernels in the integrals is also considered. Author

N65-13592 Purdue U., Lafayette, Ind.
THERMOMECHANICAL BEHAVIOR OF VISCOELASTIC MEDIA WITH VARIABLE PROPERTIES SUBJECTED TO CYCLIC LOADING
R. A. Schapery *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 245–265 refs (See N65-13577 04-34)
(Contract AF 04(611)-8539)

The interaction between heating and dynamic response of viscoelastic bodies with temperature-dependent properties is studied. Equations governing the small deformation thermomechanical response to sinusoidal loading are shown to be equivalent to a set of two variational principles. Viscoelastic properties of a solid propellant are characterized and then used in numerical examples dealing with sinusoidal shear loading of slabs and cylinders. An approximate variational method is used to calculate one-dimensional transient and steady-state temperature distributions in a massless slab. An exact steady-state solution is obtained for the thermomechanical behavior of a slab with concentrated mass, and is then used to deduce the solution for a similarly loaded cylinder. The influence of distributed mass in a cylinder is studied using a variational principle. Author

N65-13606 Rohm and Haas Co., Huntsville, Ala. Redstone Arsenal Res. Div.
A "MULTI-DATA" METHOD FOR APPROXIMATE LAPLACE TRANSFORM INVERSION
Thomas L. Cost and Eric B. Becker *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 529–543 refs (See N65-13577 04-34)
(Contracts DA-01-021-ORD-11878(Z); DA-01-021-AMC-10037 (Z))

The approximate inversion methods presently available introduce some error into the analysis even when the function to be inverted is without error. If significant error is present in

the function to be inverted, the collocation method of Schapery and the polynomial methods of Papoulis for approximate Laplace transform inversion tend to magnify the error. A method is described which tends to be less influenced by such error, and thus gives a more accurate approximation under adverse conditions. This method, termed the "multidata" method, lessens the sensitivity to error by utilizing many more values of the function to be inverted than there are degrees of freedom in the approximation. The multidata method is applied to the problem of determining the viscoelastic behavior of certain parameters in the "poker chip" test. Realistic (broad spectrum) material property representations are used. Author

N65-13609 California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.

STRESS DISTRIBUTION IN A POKER CHIP SPECIMEN SUBJECT TO COMBINED LOADS

G. H. Lindsey *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 573-582 refs (See N65-13577 04-34)

(Contract AF 33(616)-8399)

This paper deals with an extension of the regular poker chip test by simultaneously superposing a torque on the specimen, thus causing a shift in the direction and magnitude of the principal stresses. With such an extension, a wide range of conditions can be obtained that include virtually any desired combination of principal stresses from pure biaxial to equal triaxial. This generality provides a means for more completely defining failure surfaces by allowing for more points on the surface to be determined directly by experiment. In addition, the combined pulling and twisting of the poker chip provides an avenue for more thoroughly investigating the actual mechanism of multiaxial failure by allowing for many varied conditions under which fracture may initiate. Author

N65-13611 Alabama U., University.

THE STRESS DISTRIBUTION IN AN INFINITE ELASTIC SOLID PERFECTLY BONDED TO TWO UNEQUAL RIGID SPHERICAL INCLUSIONS

James L. Hill *In* APL Bull. of the 3rd Meeting, Interagency Chem. Rocket Propulsion Group, Working Group on Mech. Behavior, Vol. I Oct. 1964 p 591-606 refs Sponsored by Rohm & Haas Co. (See N65-13577 04-34)

(Contract DA-01-021-ORD-11878(Z))

The axisymmetric elasticity problem of determining the stresses in an infinite elastic solid perfectly bonded to two unequal rigid spherical inclusions subjected to a uniform axisymmetric stress state of infinity is solved. The problem was formulated in terms of bispherical coordinates and the two harmonic function approach of the Boussinesq solution was employed to obtain the results. The mathematical detail is omitted and only the results are given. Numerical results are presented for various geometric configurations that show the effect of the interaction of the inclusions on the maximum stresses. Graphical results are included that describe the general behavior of the stress distribution when the distance between the surfaces of the inclusions is 1/10 of the diameter of the larger inclusion and the smaller inclusion diameter is 1/2 the diameter of the larger inclusion. There are results for axial and radial tension at infinity when the material has values of Poisson's ratio of 0.25 and 0.5. Author

N65-13785*# Midwest Applied Science Corp., Lafayette, Ind.

STRESSES AND DISPLACEMENTS IN PRESSURIZED SPHERICAL SHELLS SUBJECTED TO LOCALIZED LOADS

John E. Goldberg and Dale W. Alspaugh Mar. 1964 37 p *Its* Rept.-64-3

(Contract NAS8-1674)

(NASA-CR-59965) OTS: HC $2.00/MF $0.50

A system of ordinary differential equations governing the behavior of spherical shells under arbitrary loads is derived. The form of these equations is such that a numerical integration technique such as the Runge-Kutta can be used. Linear equations are used, i.e., products of displacements are presumed negligible. The analysis is designed to include effects of initial pressurization, and in this sense provides an important extension. The validity of Hooke's law and the common Kirchoff hypothesis of thin shell theory is assumed. D.S.G.

N65-13860*# Harvard U., Cambridge, Mass.

AXIAL BUCKLING OF PRESSURIZED IMPERFECT CYLINDRICAL SHELLS

John Hutchinson [1964] 27 p refs

(Grant NsG-559)

(NASA-CR-59977) OTS: HC $2.00/MF $0.50

It is shown that the buckling load of an elastic shell with asymmetric imperfections, but sufficiently free of axisymmetric imperfections, closely coincides with the classical value for relatively small values of internal pressure; while the buckling load of a shell with a predominance of axisymmetric imperfection can remain well below the classical value for the entire range of internal pressures for which the shell buckles elastically. Of particular interest is the calculation of an upper bound to the buckling load as predicted by the non-linear Donnell-shell equations for a shell with axisymmetric imperfections. Author

N65-13865*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

STRESSES AND DEFLECTIONS IN CYLINDERS DUE TO CONCENTRATED LOADS

J. J. Nichols Washington, NASA [1962] 63 p refs

(NASA-TM-X-53001) OTS: HC $3.00/MF $0.75

A series of experiments were conducted on thin-walled right circular cylinders to obtain the longitudinal and circumferential stress magnitudes induced in the shell as a result of the application of a radial point load, and to obtain measurements describing the deformation pattern of the shell in the area of the loading point. Two groups of cylinders fabricated from 5052-H32 aluminum sheet stock with R/t ratios of 500 and 157 were used in the tests. As the radial load was applied, a flat, diamond-shaped buckle formed around the loading point with its diagonals longitudinally and circumferentially disposed. Existing theoretical solutions agreed with the measured stress values only where the point under investigation was outside this buckled region of the shell. As the boundary of the buckled region approached a strain gage location, the stresses at that point became nonlinear with respect to the applied load; this nonlinearity is opposed to the linear relationship given by the solutions investigated. Author

N65-13872*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE AUTOCORRELATION FUNCTION OF STRUCTURAL RESPONSE MEASUREMENTS

Richard D. Rechtien Washington, NASA, Jan. 1965 20 p refs

(NASA-TN-D-2578) OTS: HC $1.00/MF $0.50

The autocorrelation function of the response of a multi-degree of freedom system is formally derived and analyzed to determine those factors which significantly influence its characteristics. The form of the autocorrelation function is primarily governed by the joint and cross-joint acceptance function from the viewpoint of coincidence, as well as the geometric distribution of the pressure cross-power spectral density. Modal cross-coupling by damping also influences the response for some structures. Autocorrelation functions of response measurements are complex in nature and consist of a superposition of damped sine and cosine functions of many frequencies. Narrow-band filtering of the response measurements may yield autocorrelation functions possessing single degree of freedom characteristics, depending on the spatial homogeneity of the pressure correlation functions. Author

N65-13879 Aeronautical Research Council (Gt. Brit.)
INFLATED MOBILE LIFTING STRUCTURES: ANALYSIS OF MEMBRANE CONSTRUCTION AND DESIGN OPTIMISATION FOR OVAL PLANFORMS
I. S. H. Brown London, HMSO, 1964 23 p ref
(ARC-R&M-3378) HMSO: 10s

A stress analysis has been made of inflated mobile lifting structures which are considered as membranes supporting loads attached at a seam or seams on the underside. The initial treatment discusses a structure of infinite length in which the end effects can be ignored, the ends being treated later as a body of revolution. The most efficient structure is that which encloses the load with minimum base width and height of support seam; for any such given configuration and load, the bulk of tent material is proportional to the linear dimensions. For a given height and base, the horizontal position of the load support seam is not critical. Application to a construction with strengthening cords or inflated ribs is discussed, and some examples of practical design shapes are given. Author

N65-13951# Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). National Standards Lab.
VIBRATION ISOLATION
J. A. Macinante Melbourne, Commonwealth Sci. and Ind. Res. Organ., 1964 32 p refs *Its* Tech. Paper-21

This paper is in three parts: The first is a general discussion of the sources, transmission, and effects of vibration. Methods of reducing the vibration at the source are indicated, and some remarks are made on human sensitivity to vibration and the measurement of vibration. The second part gives the elementary theory of the natural frequencies and vibration-isolating properties of a rigid mass resting on spring isolators. For the two basic cases vibration applied at the mass, or at the surface supporting the isolators is shown. The calculation of natural frequencies is given in some detail, as the main task of the designer is to estimate the natural frequencies of a proposed mounting. The practical applications are dealt with in the third part, the first sections of which are general, relating to alternative types of mounting, vibration-isolating materials, and procedure for the design of a mounting. The requirements for particular kinds of equipment are then considered in the two broad classes: mountings for sources of vibration and shock, and mounting for sensitive equipment. Author

N65-13959*# Case Inst. of Tech., Cleveland, Ohio.
SYNTHESIS OF AN AIRFOIL AT SUPERSONIC MACH NUMBER
Lucien A. Schmit, Jr. and William A. Thornton Washington, NASA, Jan. 1965 101 p refs
(Grant NsG-110-61)
(NASA-CR-144) OTS: HC $4.00/MF $0.75

The system under investigation is a hollow, symmetric, double-wedge airfoil. There are two design variables, airfoil thickness and chord length. Behavior constraints are root angle-of-attack, tip deflection, flutter Mach number, and root stress. Side constraints on the design parameters are provided. The basic criterion function is the total energy required to drive the airfoil through a sequence of flight conditions. Tradeoff of weight versus energy is studied using airfoil weight as an additional behavior constraint. The gradient steep-descent alternate-step synthesis method is used. Numerical results of three example syntheses and a tradeoff study are included. Author

N65-13976 Aeronautical Research Council (Gt. Brit.)
A FREE-FLIGHT INVESTIGATION OF WING-BODY JUNCTION DESIGN FOR A TRANSONIC SWEPT-WING AIRCRAFT
G. K. Hunt London, HMSO, 1964 44 p refs
Supersedes RAE-TN-AERO-2908, ARC-25401; See X64-11325
(ARC-CP-759; RAE-TN-AERO-2908; ARC-25401) HMSO: 9s

A method of designing the body of a swept-wing–body combination, to obtain favorable wing–body interference at transonic speeds, was investigated in free flight at zero lift. Models of four different bodies, in combination with identical wings swept back 55°, were flown within the range of Mach numbers between 0.8 and 1.5 at Reynolds numbers, based on wing chord, up to 10 million. The general effectiveness of each body shape was determined by measuring the total drag of each model; the local effects of each design were determined by measuring the pressure distribution in the wing–body junction. The results show that it is possible to design a body which will produce a prescribed velocity distribution in the wing-body junction at a transonic design Mach number, but it is necessary to control the velocity distribution elsewhere on the wing in order to ensure low drag. Author

N65-13977 Aeronautical Research Council (Gt. Brit.)
FLUTTER CALCULATIONS ON A BODY WITH AFT WINGS
E. G. Broadbent and E. V. Hartley London, HMSO, 1964 30 p ref
Supersedes RAE-TN-STRUCT-337, ARC-25214; See X64-11332
(ARC-CP-761; RAE-TN-STRUCT-337; ARC-25214) HMSO: 5s 6d

The effect of body flexibility on the flutter of a body with aft wings is investigated. The missile is in free supersonic flight and the wings are assumed rigid in torsion. It is found that flutter can occur either between wing bending and the rigid body modes, or between wing bending and the fundamental bending mode of the body, depending on body stiffness. If the latter form of flutter is possible (as it usually is in practice) a higher wing stiffness is required for its avoidance. A close approximation to the quaternary flutter solution in this case is given by the appropriate binary calculation. The flutter is fairly sensitive to parameters that affect the static margin (Mach number and c.g. position) and also to structural damping. Author

N65-14112# General Applied Science Labs., Inc., Westbury, N.Y.
EXTENSION OF PROPELLER BLADE STRESS PROGRAM
E. Lieberman and J. Hoffman Oct. 1964 20 p refs
(Contract Nonr-4321(00))
(GASL-TR-466; AD-607666)

The existing IBM 7090 computer program to calculate static stress distribution of propeller blades has been revised

to generate 108 degrees-of-freedom. Two techniques were investigated: the direct inversion method, and the partitioning method. The direct inversion method has the advantage of always being able to generate a solution vector, but produces large roundoff errors and a correspondingly relatively inaccurate solution vector. The partitioning method operates on a family of submatrices of size 36 × 36 at most, rather than on the 108 × 108 matrix; three inversions are executed on these smaller sized matrices and the resulting roundoff error is nil. However, subsequent operations include subtraction of matrices of like terms and here noise is introduced. Either method, followed by appropriate iteration, will refine the solution vector to the required precision. E.E.B.

N65-14201# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

RECOMMENDED STUDIES OF VIBRATORY ENERGY DISSIPATION AND CONDUCTION IN AEROSPACE STRUCTURES Technical Documentary Report, Dec. 1962 – Apr. 1964

Eric E. Ungar Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Oct. 1964 53 p refs

(Contract AF 33(657)-10125)

(Rept.-1145; FDL-TDR-64-111; AD-609227)

Advanced aerospace structural concepts are described and reviewed with respect to the need for further information on their energy-dissipation properties. The status of the recently developed statistical energy method for vibration analysis is described, and areas where additional studies are required are pointed out. A unified review of some derivations basic to the statistical energy method is appended, as is an application of it to problems associated with measuring loss factors of nonisolated systems. Author

N65-14223# United Aircraft Corp., East Hartford, Conn. Research Labs.

DYNAMIC STABILITY MEASUREMENTS AT A MACH NUMBER OF 4.8 Quarterly Status Report No. 4, 29 Aug. – 28 Nov. 1964

Martin R. Fink Dec. 1964 32 p refs

(Contract NOw-64-0092-F)

(C91088-16; AD-454424)

Wind-tunnel measurements of dynamic and static stability coefficients of five fuselage and five wing–fuselage configurations were obtained at Mach 4.8. The models included variations of fuselage forebody shape, afterbody length, wing planform, wing axial location, and diameter to-span ratio. The measured coefficients are compared with those calculated by use of the shock-expansion method, Newtonian theory, and linearized supersonic theory. Author

N65-14229# Stevens Inst. of Tech., Hoboken, N.J. Davidson Lab.

EFFECT OF FLAPS ON THE LIFT AND DRAG OF A SURFACE-PIERCING, FULLY VENTILATED DIHEDRAL HYDROFOIL

Gerard Fridsma Nov. 1964 51 p

(Contract Nonr-263(20))

(R-978; AD-608310)

The 30° -dihedral foil was equipped with a number of full-span flaps, two 25%-chord flaps deflected 20° and 40° and two 50% flaps deflected 10° and 30° These configurations were operated over a speed range of 20 to 30 fps, at trim angles of 6° to 16°, and at submergences of 1 to 3 chords. Finite-aspect ratio and free-surface effects were removed from the test data. The corrected results thus obtained are compared with a two-dimensional nonlinear theory at infinite submergence, and good agreement is obtained. A procedure is described that can be followed to predict the three-dimensional lift and drag, at finite depth, for a surface-piercing, fully ventilated, dihedral hydrofoil with flaps. Author

N65-14270# RAND Corp., Santa Monica, Calif.

TRANSIENT RESPONSE OF A RIGID SPHERICAL INCLUSION IN AN ELASTIC MEDIUM

C. C. Mow Oct. 1964 31 p refs

(P-3001; AD-607591)

The transient response of a rigid spherical inclusion of arbitrary density embedded in an elastic medium due to an incident pulse is examined. The Fourier-integral method is used, and an exact solution of the response is obtained. It is found that the acceleration and velocity of the inclusion are substantially different from those of the medium. A slight difference in the time history of the displacement between the inclusion and the medium is also noted. Author

N65-14280# General Dynamics/Convair, San Diego, Calif.

STRUCTURAL DESIGN FOR FUEL CONTAINMENT UNDER SURVIVABLE CRASH CONDITIONS Final Report

P. M. Nissley and T. L. Heid Aug. 1964 134 p refs

(Contract FA-WA-4607)

(GDC-64-222; FAF-ADS-19)

Crash loading as related to wing structure is defined. The loading conditions considered are concentrated impact, distributed impact, and internal pressure due to fuel inertia. The probable mode of failure is described, and fuel containment design principles are listed for each condition. The study indicates that the most critical loading is concentrated impact along the front spar and lower surface as the aircraft strikes obstacles such as trees or poles. Recommended design details for fuel containment are described and illustrated for conventional and advanced structures. The recommended manner of reinforcing wings for breaking poles is to strengthen the front spar rails and the skin panels aft of the rails. If the reinforcing material is added primarily to the lower rail and lower surface, fuel containment can be efficiently improved for both the most critical and the most likely crash conditions. Author

N65-14291# Los Alamos Scientific Lab., N. Mex.

A DIGITAL COMPUTER METHOD FOR DESIGN AND ANALYSIS OF AXISYMMETRIC THIN SHELLS SUBJECTED TO PRESSURE AND THERMAL ENVIRONMENTS

J. W. Neudecker 17 Nov. 1964 214 p refs

(Contract W-7405-ENG-36)

(LAMS-3083) OTS: $6.00

This report describes a study which was carried out for the purpose of developing methods for analyzing for the stresses, deflections, and rotations induced in the pressure vessels of the Kiwi-B series nuclear rocket reactors. Emphasis is placed on the use of machine computational methods for analyzing the pressure vessels for both static test and operating conditions. A brief history is presented of the pressure-vessel development problems of Rover project reactors, and continuing problems of maintaining structural compatibility of pressure vessels and nozzles are discussed. Results of design calculations and experiments for static test conditions are presented. Author

N65-14335# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONSTRUCTION OF AN APPROXIMATE THEORY OF SHELLS BY MEANS OF ASYMPTOTIC INTEGRATION OF EQUATIONS OF THE THEORY OF ELASTICITY
A. L. Gol'denveyzer 6 Apr. 1964 24 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 27, no. 4, 1963 p 593–608
(FTD-MT-63-240; AD-608569)

With the help of the asymptotic method of integration of differential equations of the theory of elasticity, it is possible with arbitrary accuracy to construct an approximate theory of the bend of plates. Similar ideas (without emphasis on the asymptotic character of the approach) were applied with the construction of different approximate theories of bend and stretch of plates and also approximate theories of shells. Decisively important for such an approach is the idea of isolating for independent examination edge elastic phenomena expressed earlier by K. O. Friedrichs, but it was used only for the derivation of boundary conditions on the free edge of the shell. There exists a close contact between the asymptotic method of construction of an approximate theory of shells and the method of asymptotic integration of differential equations of the theory of shells. Author

N65-14336# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SEVERAL CHARACTERISTICS OF OPTICALLY SENSITIVE MATERIALS WHICH ARE SUITABLE FOR SOLUTION OF THE VISCOUS PROBLEM OF PHOTOPLASTICITY
S. I. Dobrovol'skiy 22 Apr. 1964 15 p refs Transl. into ENGLISH from Sb. Nauchn. Tr., Belorussk. Inst., Mekhaniz. S. Kh. (Belorussia), no. 2, 1959 p 221–229
(FTD-MT-63-280; AD-605607) OTS: $1.00

For studying plastic and elastic deformation in geology and metallurgy, it is highly desirable to construct models of optically transparent materials. The characteristics and methods of preparation of several materials having suitable elastic and plastic parameters are given. Among these are resin and oil mixtures, resin and butadiene mixtures, and Canada balsam. E.K.R.

N65-14423# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Aero Propulsion Lab.
EXPANDABLE STRUCTURES FOR SPACE APPLICATIONS
F. W. Forbes Oct. 1964 49 p refs
(AD-607541)

During the past decade a great deal of expandable-structure research was conducted, and investigators proposed many expandable-structure applications. This paper summarizes the major types of expandable structures: inflatable balloon, rigidized membrane, air matt, foamed-in-place, expandable honeycomb, and variable geometry structures. Emphasis is placed on materials, system characteristics, and advancements required to perfect each type of expandable structure. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-13377 AiResearch Mfg. Co., Los Angeles, Calif.
AN EXPERIMENTAL INVESTIGATION OF FORCED-CONVECTION VAPORIZATION OF POTASSIUM
P. J. Berenson and J. J. Killackey *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Dec. 1964 p 1–23 refs (See N65-13376 04-34) OTS: $7.00
(Contract AF 33(657)-10922)

A test program is described in terms of test equipment, instrumentation, test operation, data processing, and a discussion of results. The equipment is diagramed, and results are presented in tables and graphs. The boiler is a shell-and-tube design with lithium flowing outside the tubes and potassium vaporizing inside the tubes. Test results obtained show that the boiling heat-transfer coefficient ranges down from 54 000 Btu/hr ft^2 °F at 20% quality to about 10 000 Btu/hr ft^2 °F at 60% quality, and that the lithium side controls the boiler heat-transfer rate, and hence the size. The first test series was conducted using a "whirler" or twisted ribbon as the tube insert, in order to exert a positive means to drive the remaining liquid droplets in the high-velocity vapor core to the tube wall, where vaporization would occur. D.E.W.

N65-13378 Atomics International, Canoga Park, Calif.
SUMMARY OF RECENT RESULTS OF SODIUM BOILING STUDIES
R. C. Noyes *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Dec. 1964 p 24–46 refs (See N65-13376 04-34) OTS: $7.00
(Contract AT(11-1)-GEN-8)

New pool measurements of nucleate boiling heat-transfer coefficient for saturated sodium were accomplished with improved experimental accuracy. Results show sodium to exhibit conventional boiling behavior and to have heat-transfer coefficients slightly higher than those predicted elsewhere. Stainless, clad, cromel–alumel surfaces had slightly higher coefficients than molybdenum surfaces. A new nondimensional correlation of burnout heat flux in pool boiling was developed which brings sodium measurements into agreement with measurements on sulfur, water, and organic materials. A new working loop for experimental study of sodium forced-convection boiling heat transfer and two-phase flow was put into operation. Preliminary heat-transfer results indicate that, under slightly subcooled conditions, sodium behaves as would be expected from pool boiling results. Initial measurements of void fraction in two-phase flow at 8 psia and low quality show void fractions somewhat lower than predicted by Lockhart–Martinelli. D.E.W.

N65-13379# Brookhaven National Lab., Upton, N.Y.
A PROPOSED MECHANISM AND METHOD OF CORRELATION FOR CONVECTIVE BOILING HEAT TRANSFER WITH LIQUID METALS
John C. Chen Aug. 1963 *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Dec. 1964 p 47–63 refs (See N65-13376 04-34) OTS: $7.00

An additive, interacting mechanism of micro- and macro-convective heat transfer is proposed to represent boiling heat transfer with net vapor generation to saturated liquid metals in convective flow. Based on this mechanism, a method for calculating boiling coefficients is developed. The correlating is in fair agreement with early experimental results for convective boiling of potassium and sodium. Author

N65-13380 Aerojet-General Nucleonics, San Ramon, Calif.
HEAT TRANSFER AND PRESSURE DROP CHARACTERISTICS FOR BOILING RUBIDIUM IN FORCED CONVECTION
C. R. Fisher *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Dec. 1964 p 64–85 refs (See N65-13376 04-34) OTS: $7.00
(Contract AT(04-3)-368)

This paper describes the results of an experiment performed to determine the heat transfer and pressure drop characteristics of boiling rubidium in forced convection. The following ranges of operating parameter were included in this investigation: mass flow rate, 117 000 to 880 000 lb/hr-ft^2; saturation temperature, 1300° to 1800° F; heat flux, 0 to 325 000 Btu/hr-ft^2; inlet subcooling, 200° to 400° F; outlet quality, 0 to 0.8; test section, 0.28-in.-i.d., smooth, round tube; pressure drop/saturation pressure, 0 to 0.15. Author

N65-13381 General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section
ALKALI METALS BOILING AND CONDENSING INVESTIGATIONS
Joseph Longo, Jr. and Robert D. Brooks *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Dec. 1964 p 86–109 refs (See N65-13376 04-34) OTS: $7.00
(Contract NAS3-2528)

Descriptions are given of the 300 kW facility and its operation, the 100 kW test facility and its resultant data, the 50 kW facility and its use for condensation studies, and data from the 50 kW facility. With the 300 kW facility it was found that the boiling thermal resistance is quite small with respect to the overall thermal resistance when the boiler is in nucleate boiling along its entire length at potassium temperatures above 1600° F. The effects of various changes in experimental conditions on the obtained heat-transfer coefficients are discussed at length. During the operation of the 50 kW facility, "shakedown" liquid-phase and condensing heat-transfer data were obtained for potassium, using the radial temperature profile in the thick-walled nickel tube to determine the local heat flux and inner wall temperature. D.E.W.

N65-13382# General Motors Corp., Indianapolis, Ind. Allison Div.
POTASSIUM-MERCURY AMALGAM BOILING HEAT TRANSFER, TWO-PHASE FLOW, AND PROPERTIES INVESTIGATION
Y. S. Tang, C. R. Smith, and P. T. Ross *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Dec. 1964 p 110–131 refs (See N65-13376 04-34) OTS: $7.00

The results of a series of experiments using 44.5% K amalgams and 14.7% K amalgams are reported. The experimental apparatus and instrumentation are described and diagramed. Values of heat-flux density for the net boiling region of the test section are plotted in a graph as a function of wall superheat. Considerably higher wall superheat was required for the 14.7% K amalgams; this phenomenon tends to be similar to that experienced with pure mercury. During these tests, a major portion of the test section for all experiments experienced surface boiling where the heating surface temperature (inner tube wall) exceeded the fluid saturation temperature. Data presented exhibit considerable scatter, and no single correlation can be drawn. The results are compared with pure component data. Also, results are presented for the study of binary two-phase liquid metal flow and are compared with data from other related investigations. A liquid-vapor phase equilibrium diagram is given, and studies of the thermal diffusivity, vapor pressure, surface tension, and latent heat of vaporization are discussed. D.E.W.

N65-13383# Massachusetts Inst. of Tech., Cambridge.
HEAT TRANSFER DURING FILM CONDENSATION OF A LIQUID METAL VAPOR
S. P. Sukhatme and W. M. Rohsenow *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Dec. 1964 p 132–152 refs (See N65-13376 04-34) OTS: $7.00

A modified theory of film condensation is presented, during which the condensation coefficient, the saturation temperature and the liquid temperature at the liquid–vapor interface are discussed. A modified form of Nusselt's theory is discussed, taking account of the resistance at the vapor–liquid interface. The apparatus used to test the theory is a closed boiler–condenser system made of stainless steel 304. Mercury is used as the working fluid. The condenser is a vertical nickel tube on which the nature of the condensation is observed through vycor windows mounted in the walls of the test chamber. Water is the cooling liquid. D.E.W.

N65-13384# Electro-Optical Systems, Inc., Pasadena, Calif.
LIQUID METAL JET CONDENSERS
Lance Hays *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Dec. 1964 p 153–197 refs (See N65-13376 04-34) OTS: $7.00

An investigation of jet condensers using mercury as a working fluid was concluded. The application which motivated this work was the use of this component as a vapor condenser in space dynamic power systems. Advantageous features such as high condensation rates, positive vapor–liquid separation, simple start-up, and significant conversion of vapor thermal energy to condensate mechanical energy were demonstrated and are discussed. Simplified expressions for momentum exchange and heat transfer were obtained and are used to correlate experimental results obtained with mercury, and to indicate trends of performance available with variations in geometric and fluid parameters. Author

N65-13385 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FOG-FLOW MERCURY CONDENSING PRESSURE DROP CORRELATION
A. Koestel (Thompson Ramo Wooldridge), M. Gutstein, and R. T. Wainwright *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Dec. 1964 p 198–234 refs (See N65-13376 04-34) OTS: $7.00

A theory is presented to predict the local pressure drops of mercury vapor flowing and condensing inside tubes. The theory is based on the assumption that condensation takes place at the tube wall and, subsequently, drops are entrained into the vapor as a fine dispersion or fog. A relationship between $\Phi^2 \chi^{3/4}$ and the Weber number is derived from the analysis, where Φ^2 is the two-phase frictional pressure gradient ratio and χ is the quality. Experimental data from several sources were examined and are shown to correlate well with the theory. Author

N65-13386 Rocketdyne, Canoga Park, Calif.
HEAT TRANSFER FROM A HOT SODIUM SPRAY IMPINGING ON A VERTICAL PLATE
W. H. Nurick, J. D. Seader, and T. A. Coultas *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Dec. 1964 p 235–249 ref (See N65-13376 04-34) OTS: $7.00

A study of heat transfer by hot particles to a solid propellant surface is reported. Although aluminum and zirconium oxides and potassium chloride are typical hot particle materials, the experimental work reported was done at lower temperatures where measurements are more convenient. Sodium was used

because of easy handling and wide liquid temperature range. Major variables are droplet size, impingement angle, physical properties, flow rate per unit area, and impingement velocity. Results at 1100° F indicate that the heat transfer coefficient varied from about 360 to 530 Btu/hr-ft^2-° F when the sodium driving pressure was varied from 300 to 900 psig. This corresponded to a variation in flow rate per unit area of about 0.68 to 4.90 lb/sec-ft^2. D.E.W.

N65-13387 MSA Research Corp., Callery, Pa.
MEASUREMENT OF THE PRESSURE DROP OF SUPERHEATED CESIUM VAPOR ACROSS A LAMINAR FLOW DEVICE
William A. Samuel *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Dec. 1964 p 250–269 (See N65-13376 04-34) OTS: $7.00

An apparatus was built in which cesium was boiled and the vapor subsequently superheated. The pressure drop created by the passage of this vapor through a capillary was measured at various flow rates by means of an attitude-insensitive device. The problem of determining the vapor throughput was resolved by actually condensing the cesium and measuring its volume. The experimental equipment included the boiler, superheater, control panel, collection apparatus, capillary, differential pressure device, and electronic components to read out the position of the differential pressure device. A plot was made of flow rate versus differential pressure, and this was compared with the theoretical value. The agreement was quite good and indicated how this method might be used as a means of measuring the viscosity of superheated vapors. D.E.W.

N65-13438# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AERODYNAMIC CHARACTERISTICS OF A FLAME ON OUTLET FROM BURNERS WITH TANGENTIAL BLADE AIR FEED
K. B. Akhmedov 9 Jan. 1964 18 p refs Transl. into ENGLISH from Teploenerg. (Moscow), v. 10, no. 1, 1963 p 28–33
(FTD-MT-63-193; AD-606281)

A typical burner with tangential blade air feed is diagrammed and described, and twisted or helical flow is examined theoretically. An apparatus for measurements of the aerodynamic characteristics and structure of the gas flow and of the flame is described, and the fields of axial and tangential speeds at the outlet of the burner and inside the cylindrical recess of the burner are discussed. Conclusions are stated concerning the intensity of the twist, the angle of delivery of the flame, the high-speed irregularity of airflow, and various influences on the degree of irregularity of flow. D.E.W.

N65-13448*# National Bureau of Standards, Washington, D.C. Heat Div.
A SURVEY OF THERMODYNAMIC PROPERTIES OF THE COMPOUNDS OF THE ELEMENTS CHNOPS Progress Report, 1 Aug.–31 Oct. 1964
George T. Armstrong, Eugene S. Domalski, George T. Furukawa, and Mary A. Krivanec 1 Nov. 1964 34 p refs
(NASA Order R-138)
(NASA-CR-59922; NBS-8595) OTS: HC $2.00/MF $0.50

Two papers are presented, one on the analysis of heat-capacity data on 17 amino acids, and the other on the heats and free energies of formation of compounds of C, H, N, O, P, and S. In the first paper, an IBM 7094 computer was used to calculate thermodynamic properties from the smoothed values of heat capacity, and the results are tabulated from 0° to 300° K. In the second paper, data on numerous compounds containing not more than one C atom per molecule is presented in tables. D.E.W.

N65-13451# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF EXPLOSIVES Collection of Articles
K. K. Andreyev, A. F. Belyayev, A. I. Gol'binder, and A. G. Gorst, ed. 31 Jan. 1964 823 p refs Transl. into ENGLISH of the book "Teoriya Vzryvchatykh Veshchestv" Moscow, Gos. Nauchno-Tekhn. Izd., 1963 p 3–579
(FTD-MT-63-254; AD-605706)

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N65-13452# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE QUESTION OF EXCITATION OF EXPLOSION DURING DEFORMATION OF THE EXPLOSIVE CHARGE

N. A. Kholevo *In its* Theory of Explosives 31 Jan. 1964 p 5–26 refs (See N65-13451 04-33)

The role of stresses in the excitation of an explosion from a deformed explosive is discussed. Two instruments for testing the sensitivity of an explosive to drop-hammer impact are described, and results obtained from the instruments are compared. From the experimental data obtained, it is concluded that the probability of triggering an explosion is not always in direct dependence on the stresses appearing at impact; in cases of low speed of flow of a charge, an explosion is not triggered even with very large stresses. The effectiveness of the action of mechanical forces during flow of a charge is determined by the specific speed of separation of mechanical energy, which depends on the coefficient of internal (and external) friction and on the gradient of the speed of flow. P.V.E.

N65-13453# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RECENT INVESTIGATIONS OF DECOMPOSITION OF HARD TYPE EXPLOSIVES (VV)

F. Bouden *In its* Theory of Explosives 31 Jan. 1964 p 27–46 (See N65-13451 04-33)

The triggering of an explosion in solid explosives by heating the explosive to ignition temperature, by applying light of

sufficient intensity to cause an explosion, and by explosion through impact or shock is discussed. The thermal decomposition of crystals of solid explosives is also discussed, and it is indicated that the decomposition starts from the surface in dislocations and defects of the crystal lattice and leads to the splitting of the crystal into tiny fragments. The most dangerous factor with respect to triggering an explosion on impact is the presence of small bubbles of air in liquids and in certain solid crystals. The production of explosion by friction and shock waves is also considered. Author

N65-13454 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING THE QUESTION OF FACTORS STIPULATING THE APPEARANCE OF EXPLOSION ON IMPACT AND FRICTION AND ABOUT METHODS OF APPRAISAL OF SENSITIVITY OF EXPLOSIVES (VV) TO MECHANICAL EFFECTS
K. K. Andreyev *In its* Theory of Explosives 31 Jan. 1964 p 47–70 refs (See N65-13451 04-33)

In the triggering of an explosion by mechanical means the appearance of local heat-ups in the solid explosive is necessary. These heat-ups can be formed during nonuniform flow of the explosive, during compression of gas bubbles in it, during friction of particles, from refractory impurities, or from hard surfaces, one of which is the explosive. The development of the chemical reaction appearing in seats of heat-up, into burning and explosion depends on the temperature, dimensions, and pressure in the heat-up. To appraise the sensitivity it is necessary to determine a complex of properties of the explosive—the frequency of explosions during drop hammer and friction tests, the ability to perceive and transmit detonation at a distance, and the critical diameters of the charge during burning and detonation. The real danger of triggering explosions by mechanical means depends also on the flow capabilities of the explosive, on the appearance of local heat-ups, and on the maintenance of pressure favoring the development of the initial transformation to explosion. Author

N65-13455 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT THE TRIGGERING OF AN EXPLOSION ON IMPACT AND METHODS DESCRIBING THE SENSITIVITY OF EXPLOSIVES MECHANICAL EFFECTS
K. K. Andreyev and Yu. A. Terebilina *In its* Theory of Explosives 31 Jan. 1964 p 71–98 (See N65-13451 04-33)

A complex method of determining the relative sensitivity of a solid explosive to mechanical effects is proposed. An explosive is subjected to impact between the wood surfaces of two rollers of significant diameter, in which the space surrounding the joint of rollers is open; the size of the batch and its location on the rollers vary. Advantages of this method in comparison with the standard are the possibility of differentiating the chemical and physical factors of the sensitivity and the efficient design of the instrument. Author

N65-13456# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING THE QUESTION OF THE INFLUENCE OF AIR ON THE APPEARANCE OF EXPLOSION UNDER IMPACT
K. K. Andreyev and Yu. A. Terebilina *In its* Theory of Explosives 31 Jan. 1964 p 99–113 refs (See N65-13451 04-33)

Experiments are described which indicate that not only is high temperature an essential element in explaining the role of bubbles in causing explosives to ignite, but also the conditions of interaction, in particular heat exchange, of the compressed heated gas with adjacent explosives are important. The experiments discussed made use of a roller-type instrument to impart impact to an explosive. It was found that the frequency of explosions of certain highly sensitive explosives (nitroglycerine, lead azide, etc.) to impact is sharply increased if the roller, transmitting the blow, is not placed on the substance, but is held at a certain height above it. It is concluded that this effect is apparently connected with the capture of the compressed flow of air which in turn leads to the ignition of the explosive. P.V.E.

N65-13457# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING THE QUESTION OF MECHANISM OF APPEARANCE OF EXPLOSION DURING TEST OF SENSITIVITY TO IMPACT IN A ROLLER INSTRUMENT
K. K. Andreyev and Yu. A. Terebilina *In its* Theory of Explosives 31 Jan. 1964 p 114–124 refs (See N65-13451 04-33)

Experiments were conducted to show directly that the flow of explosive in the radial clearance (space between the rollers) of a roller instrument can lead to explosions. In addition, the experiments were used to determine precisely why such flow leads to an explosion. Under the usual conditions of a drop-hammer test, even organic nonexplosive substances are decomposed, indicating that the flow during impact leads to significant heat-ups. It is concluded that in the explosion of a liquid explosive in a roller instrument under impact, the decisive factor leading to the explosion is the pressing of the substance through a narrow gap, which leads to the appearance of local seats of reaction. This reaction will develop into an explosion if there is, near the seat, a layer of explosive whose thickness exceeds the critical thickness for propagation of combustion at a given pressure. P.V.E.

N65-13458 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE BASIC FACTORS, DETERMINING THE DANGER OF EXPLOSIVES DURING MECHANICAL ACTION, AND METHODS OF ITS ESTIMATION
K. K. Andreyev *In its* Theory of Explosives 31 Jan. 1964 p 125–132 refs (See N65-13451 04-33)

The fundamental properties of an explosive, in determining its danger with regard to mechanical action, are the thermokinetic characteristics, developed in critical diameters for burning and for detonation. The possibility of explosions resulting from the mechanical actions of burnup and pressure, sufficient for the excitation of burning, depends on the deformation and fluidity of the substance. Usually the danger is greater for very viscous fluid substances and can be estimated by the action of slipping impact. Author

N65-13459# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON CERTAIN FOREIGN INVESTIGATIONS IN THE METHODOLOGY OF EXPERIMENTAL DETERMINATION OF SENSITIVITY OF EXPLOSIVES TO IMPACT
K. K. Andreyev *In its* Theory of Explosives 31 Jan. 1964 p 133–180 refs (See N65-13451 04-33)

Various experimental data and conclusions of foreign (non-U.S.S.R.) investigators in the field of experimental determination of the sensitivity of explosives to impact are discussed and compared to the data and conclusions of N. A. Kholevo. The results are discussed with regard to the dependence of

explosive sensitivity on the flow of the explosive at impact by a drop hammer (presence and magnitude of gaps), the ability of the explosive to flow (with a distinction between powdery explosives, and liquid and gelatinous explosives), and the optionality of parallelism between frequency of explosions and height of fall of a load (in drop-hammer tests). P.V.E.

N65-13460 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE INFLUENCE OF WATER ON THE DECOMPOSITION OF NITROGLYCERINE AT INCREASED TEMPERATURES

K. K. Andreyev and G. N. Bespalov *In its* Theory of Explosives 31 Jan. 1964 p 181–235 refs (See N65-13451 04-33)

The methods used and the results obtained in studying the influence of water on decomposed nitroglycerine are discussed in detail. The basic method used was the measurement of the pressure of the formed gases, using a Bourdon-type manometer. Conclusions reached include the following: (1) The presence of water greatly influences the disintegration of NG at increased temperatures. (2) With small quantities of water, the type of disintegration inherent to anhydrous NG is maintained but proceeds at a faster pace. (3) With average quantities of water three periods of disintegration are observed: constancy of pressure (induction period), fall of pressure, and growth of pressure. The last period proceeds faster the more water there is present. (4) With large quantities of water, disintegration can be greatly delayed. P.V.E.

N65-13462# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE THERMAL DECOMPOSITION OF NITROGLYCERINE IN THE LIQUID-PHASE

B. S. Svetlov *In its* Theory of Explosives 31 Jan. 1964 p 252–262 refs (See N65-13451 04-33)

In first stage of decomposition, gasiform products of disintegration show practically no accelerating effect on the speed of gas formation. The initial speed of the latter depends on the degree of filling of the reaction vessel and is characterized by the normal temperature coefficient of this speed for nitro esters. In the second stage of decomposition, the speed of gas formation depends on the pressure of gasiform products of disintegration approximately to the second degree and can exceed the initial speed by at least a hundred times. The results obtained are considered in the light of the assumption of a simultaneous flow of two processes of decomposition of nitroglycerine. The first represents spontaneous decomposition, not accelerated by gasiform products of disintegration. During the second process interaction of nitroglycerine with the products of its disintegration occurs, with the speed depending on the composition of these products. Author

N65-13463# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE INFLUENCE OF TEMPERATURE ON DECOMPOSITION OF NITROGLYCERINE

V. V. Gorvunov and B. S. Svetlov *In its* Theory of Explosives 31 Jan. 1964 p 263–273 refs (See N65-13451 04-33)

The decomposition of nitroglycerine at low temperatures (40° to 100° C) is qualitatively similar to the disintegration of nitroglycerine at higher temperatures (80° to 140° C). This similarity lies in the presence of two macroscopic stages, in critical pressure, and in the approximate proportionality of rate of gas formation in the second stage to the square of the pressure of the products of disintegration. There is also quantitative distinction in the disintegration of nitroglycerine during low and high temperatures; the temperature dependence of the initial rate of gas formation during low temperatures is weaker. In the second stage of decomposition, the critical increment of the rate of gas formation constitutes nearly 15 kcal/gram-molecule, differing from high temperatures at which the rate of gas formation in the second stage is virtually independent of temperature. An estimation is made of the magnitude of the induction period of nitroglycerine disintegration at 20° C. A methodology for studying the thermal disintegration of explosive substances at a maximum degree of reaction vessel filling, is developed, making it possible to widen the investigation in the area of lower temperatures. Author

N65-13464# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF WATER AND ACID ON SELF-ACCELERATED DISINTEGRATION OF NITROGLYCERINE

V. V. Gorbunov and B. S. Svetlov *In its* Theory of Explosives 31 Jan. 1964 p 274–290 refs (See N65-13451 04-33)

The thermal decomposition of nitroglycerine was studied in the presence both of water and of nitric acid of different concentrations at 40° to 100° C under conditions such that the substances added to the nitro ester, as well as the products of disintegration, are almost completely dissolved in the ester. Water reduces the induction period of disintegration of nitroglycerine at an approximately equal degree in the studied temperature range; nitric acid affects disintegration at high temperature less than water but is significantly stronger than water at low temperature. By extrapolation the time of the induction period at 20° C was estimated for humid and acid nitroglycerine. Author

N65-13465 Air Force Systems Command, Wright-Patterson, AFB, Ohio. Foreign Technology Div.

ON THE ROLE OF NITROGEN DIOXIDE IN THE SELF-ACCELERATED DECOMPOSITION OF NITROGLYCERINE

B. S. Svetlov *In its* Theory of Explosives 31 Jan. 1964 p 291–299 refs (See N65-13451 04-33)

Determination of the solubility of nitrogen dioxide in nitroglycerine was made using weight and manometric methods. The solubility was proportional to the amount of nitrogen dioxide present by a factor of 1.5 to 2.3. Experiments were conducted to determine the influence of temperature on the solubility of nitrogen tetroxide in nitroglycerine over a temperature range of 30° to 80° C. The dependence of the solubility on temperature could be expressed by the equation

$$\log K = \frac{3060 \pm 100}{RT} - 8032$$

In the presence of an equilibrium mixture of $NO_2 - N_2O_4$ nitroglycerine dissolves mainly nitrogen tetroxide. P.V.E.

N65-13466# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE ROLE OF CONDENSATION PRODUCTS IN THE DISINTEGRATION OF NITROGLYCERINE

V. V. Gorbunov and B. S. Svetlov *In its* Theory of Explosives 31 Jan. 1964 p 300–307 refs (See N65-13451 04-33)

An attempt was made to show the presence and to estimate the role of condensation products in the disintegration of nitroglycerine. A manometric method was used to study the decomposition. The gaseous and highly-volatile products were removed, and decomposition of the remaining substance was studied. The gas formation during the disintegration of partially decomposed NG, after the removal of volatile products, was found to proceed with great speed which diminishes in time. The temperature coefficient for this process is less than that of the decomposition of pure NG. Disintegration of partially decomposed NG was qualitatively similar to the disintegration

of NG in the presence of oxalic acid. The speed of self-accelerated decomposition of NG in the presence of the products of disintegration is determined not only by the highly volatile products, but also by the formation of nonvolatile intermediate products of decomposition. P.V.E.

N65-13467# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE SOLUBILITY OF WATER IN NITROGLYCERINE
V. V. Gorbunov *In its* Theory of Explosives 31 Jan. 1964 p 308–317 refs (See N65-13451 04-33)

The solubility of water in nitroglycerine at temperatures of 30° to 90° C and in diglycoldinitrate and dinitroglycerine at 120° C was determined. The solubility constant of water in nitroglycerine varies in the given limits of temperature from $95 \cdot 10^{-6}$ mm^{-1} to $13 \cdot 10^{-6}$ mm^{-1}; the solubility constant of water in diglycoldinitrate is somewhat less ($5.2 \cdot 10^{-6}$ mm^{-1} at 120° C), but in dinitroglycerine is much larger ($36 \cdot 10^{-6}$ mm^{-1} at 120° C) than in nitroglycerine ($6.6 \cdot 10^{-6}$ mm^{-1} at 120° C). The solubility of water in nitroglycerine containing 0.3% to 0.6% by weight, of nitric acid is 5 to 7 times more than its solubility in a neutral product at the same temperatures. Author

N65-13468# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE THERMAL DISINTEGRATION OF NITROGLYCERINE AND THE POSSIBILITY OF ITS TRANSITION TO EXPLOSION
K. K. Andreyev *In its* Theory of Explosives 31 Jan. 1964 p 318–340 refs (See N65-13451 04-33)

The parameters which regulate the thermal disintegration of nitroglycerine were investigated along with conditions which determine the possibility of a flash being triggered as a result of strong self-acceleration of the disintegration. The disintegration of NG, when proceeding slowly and without acceleration, can be strongly accelerated if the products of the disintegration are retained. The onset of acceleration of decomposition occurs much faster if the NG contains impurities—water (within a limit) and acids or oxides of nitrogen. The reactions leading to self-acceleration show a strong dependence on the concentration of the products of disintegration or impurities, and a weak dependence on the temperature. As a result, if a high concentration of accelerating substances is attained, disintegration can lead to a thermal triggering of flash even at very low temperatures and relatively small dimensions of charge. P.V.E.

N65-13469# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMAL DISINTEGRATION OF PETN
K. K. Andreyev and B. I. Kaydymov *In its* Theory of Explosives 31 Jan. 1964 p 341–384 refs (See N65-13451 04-33)

Disintegration of PETN in melt, solution, vapor, and solid state was studied by the manometric method. The disintegration rate was biggest in the vapor state and smallest in the solid state. Melt and solution (in trotyl) are identical in rate of decomposition and occupy an intermediate position, near other nitro esters (nitroglycerine, nitroglycol). Disintegration in vapor proceeds at a rate diminishing in time. In liquid and solid states two macrostages of disintegration are observed: (1) with a small slightly increasing rate, not accelerated by gasiform products of disintegration and (2) characterized by a strong increase of rate in connection with hydrolytic action of formed water, strengthened by acid products of disintegration. The decomposition rate of solid PETN increases also as a result of its partial liquefaction by products of disintegration. The comparatively high stability of PETN at normal temperatures is due to its solid state. Author

N65-13470# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMAL DISINTEGRATION OF DIETHYLENE GLYCOL NITRATE IN THE LIQUID PHASE
B. S. Svetlov *In its* Theory of Explosives 31 Jan. 1964 p 385–395 refs (See N65-13451 04-33)

The disintegration of diethylene glycoldinitrate was studied in the liquid phase, in the presence of products of disintegration at 60° to 150° C and with a test ampoule filled from 0.001% to 0.9 with nitro esters. The initial speed of gas formation is described by an Arrhenius equation, where E = 41 to 42 kcal mole and lg B = 16.5, which is very close to the corresponding constants of decomposition of other nitro esters in the liquid phase. Under the conditions of the experiment, disintegration of diethylene glycoldinitrate occurs without sharp acceleration, and is not accelerated by the addition of water. In the products of decomposition of diethylene glycoldinitrate, the absence of noticeable quantities of nitrogen peroxide can be explained by the fact that oxidizing processes at disintegration occur significantly faster than primary separation of nitrogen peroxide. At relatively low temperature (60° C and lower) decomposition of diethylene glycoldinitrate occurs ten times slower than nitroglycerine, indicating its comparatively high stability. Author

N65-13471 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE INFLUENCE OF CERTAIN IMPURITIES ON THERMAL DISINTEGRATION OF DIETHYLENEGLYCOL DINITRATE
B. A. Lur'ye and B. S. Svetlov *In its* Theory of Explosives 31 Jan. 1964 p 396–419 refs (See N65-13451 04-33)

The thermal disintegration of diethyleneglycol dinitrate in the presence of oxygen, NO_2, NO, and nitric and oxalic acids at 80° to 120° C was studied. It was found that at increased temperatures, liquid DEGDN is able to interact with oxygen, NO_2, and NO, and the reaction proceeds with a decrease in the volume of these gases. Concentrated nitric and oxalic acid accelerate the decomposition of DEGDN by tens and even hundreds of times. Dilution of nitric acid strengthens the acceleration of gas generation; in case of oxalic acid, dilution retards decomposition. The sharp acceleration observed during the disintegration of DEGDN in the presence of certain substances is accompanied by accumulation of NO_2 and is changed after passage of the disintegration rate through a maximum by retardation of gas formation and gradual disappearance of nitrogen peroxide. Author

N65-13472 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMAL DECOMPOSITION OF DINITRATE OF ETHYLENE GLYCOL AND TRINITRITE OF GLYCERINE
B. N. Kondrikov *In its* Theory of Explosives 31 Jan. 1964 p 420–477 refs (See N65-13451 04-33)

Investigations of the thermal disintegration of esters of nitrous acid are reviewed. The gas phase thermal disintegration of glycerine trinitrite at temperatures of 120° to 190° C at an initial concentration of 50- to 1000-mm Hg is discussed in particular. The disintegration included at least two macroscopic stages. The mechanism for the first stage is analogous to the mechanism of the disintegration of mononitrites. The second stage reactions have a self-accelerating, significantly heterogeneous character, and their "specific gravity" increases considerably with an increase of concentration of dinitrite and a lowering of the temperature of the experiment. P.V.E.

N65-13473 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THERMAL DISINTEGRATION OF VAPORS OF NITRO DERIVATIVES OF BENZENE

Yu. Ya. Maksimov *In its* Theory of Explosives 31 Jan. 1964 p 478–492 refs (See N65-13451 04-33)

The thermal decomposition of mononitrobenzene, 1,3-dinitrobenzene, and 1,3,5-trinitrobenzene was studied by the manometric method. The thermal decomposition of vapors of mono-, di-, and tri-nitrobenzene was found to possess a number of common traits. For all three substances the activation energy, determined on the initial stage of decomposition, was practically identical and lay within the limits of 51.9 to 53.5 kcal/mole. Also, the constant speed of the initial reaction of decomposition was dependent on the concentration of the substance in volume. It is concluded that the type of reaction involved in the disintegration of the three substances follows the autocatalytic law $dx/dt = k_1(a - x) + k_2x(a - x)$, where a is the initial quantity of substance, x is the quantity of decomposed substance, k_1 is the constant speed of the monomolecular reaction, and k_2 is the constant speed of the autocatalytic reaction. P.V.E.

N65-13474# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THERMAL DISINTEGRATION OF PICRIC AND STYPHNIC ACIDS

K. K. Andreyev and Pao-feng Liu *In its* Theory of Explosives 31 Jan. 1964 p 493–512 refs (See N65-13451 04-33)

Using a glass manometer, the disintegration of picric and styphnic acids in the interval of temperature range from 183° to 270° C was studied. This disintegration proceeds in a complicated form and includes a series of stages, distinguished by the character of the dependence of rate on time; on the whole it proceeds without significant acceleration and in this respect is distinguished from the disintegration of trinitrobenzene, trinitrotoluene, and many other nitro compounds of aromatic hydrocarbons. The following kinetic characteristics were determined for the main stage of disintegration: for picric acid, E = 38.6 kcal/mole, $B = 10^{11.6}$, and half-life at 230° is 470 min; for styphnic acid, E = 34.6 kcal/mole, $B = 10^{11.2}$, and half-life at 230° is 45 min. In the vapor state picric acid is decomposed significantly slower than in the liquid phase; with the homogeneous reaction, a heterogeneous reaction occurs with significant speed on the surface of the glass. Author

N65-13475# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THERMAL DISINTEGRATION OF AMMONIUM, POTASSIUM, AND LEAD SALTS OF PICRIC AND STYPHNIC ACIDS

K. K. Andreyev and Pao-feng Liu *In its* Theory of Explosives 31 Jan. 1964 p 513–567 ref (See N65-13451 04-33)

The kinetics of slow thermal disintegration of ammonium, potassium, and lead salts of picric and styphnic acids were studied. The disintegration of all the studied substances showed a self-accelerated multistage character, different for various substances. The disintegration rates of the salts of a given acid, in the studied temperature region, were lower on the whole than the disintegration rate of the acid itself. Potassium salts disintegrated slower than lead salts, which in turn decomposed slower than ammonium salts. The temperature coefficients of disintegration rate for salts are in general greater than those for the corresponding acids; picrate of lead has an especially great temperature coefficient of disintegration rate. The disintegration rates of styphnic acid and its salts are significantly larger than those of picric acid and its corresponding salts. Hypotheses are expressed about the burning mechanism of quick-burning substances, which explain the possible absence of a decisive influence of the rate of thermal disintegration on burning rate and burning ability. Author

N65-13476 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THERMAL DECOMPOSITION OF AMMONIUM NITRATE

A. A. Shidlovskiy *In its* Theory of Explosives 31 Jan. 1964 p 568–571 refs (See N65-13451 04-33)

An attempt was made to establish how catalysts behave in the decomposition of ammonium nitrate. In the experiments, ammonium nitrate was heated in an air bath to 200° ±3° C. After bringing the temperature of the fused NH_4NO_3 to 200° C, weighed amounts of powdered CrO_3 or $K_2Cr_2O_7$ in quantities from 0.01 to 0.3 g were poured on the surface of the NH_4NO_3. The quantity of catalyst necessary for full decomposition of the fused NH_4NO_3 did not grow proportionally to the weight of the nitrate, but significantly slower. With a large mass of fused nitrate, the action of the catalyst was localized; thus, the main criterion for the violent decomposition of NH_4NO_3 is the creation of a zone in the nitrate in which there would be a sufficiently large concentration of catalyst. P.V.E.

N65-13477# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE QUESTION OF THE FACTORS DETERMINING THE DEPENDENCE OF THE BURNING RATE OF EXPLOSIVES ON THE INITIAL TEMPERATURE AND PRESSURE

K. K. Andreyev *In its* Theory of Explosives 31 Jan. 1964 p 572–590 refs (See N65-13451 04-33)

The burning rate is shown to be nearly proportional to the pressure for a series of secondary explosives belonging to the class of nitro esters and nitro compounds. From this it is concluded that, according to the Zeldovich–Belyayev theory, the leading reaction during the burning of substances of this class is bimolecular. The burning rate of the same series of explosives is shown to be approximately connected to the heat and temperature of burning by a linear dependence. It is also shown by the method of dilution by inert impurities, that the dependence of the burning rates of PETN and tetryl on their calculated burning temperatures is identical in character, is in agreement with theoretical calculations, but differs quantitatively; the dependence is stronger for PETN than for tetryl. Author

N65-13478# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE BURNING OF NITRATES OF CERTAIN ALCOHOLS

K. K. Andreyev *In its* Theory of Explosives 31 Jan. 1964 p 591–609 refs (See N65-13451 04-33)

The dependence of the burning rate of liquid substances on pressure and initial temperature (in particular, nitrates of alcohol) differs, because of turbulence of the front, setting in under definite conditions of burning, from that of solid substances. The main factors determining the transition of burning into a turbulent regime are the magnitude of the burning rate and the pressure. Turbulence leads to a sharp increase in the quantity of liquid proceeding into the zone of burning, which can, at low pressures, cause its attenuation, but at high pressures strongly increases the quantity of the burning substance. The appearance of turbulent burning during an increase in pressure can lead to a transition of burning into an explosion, especially at low pressures. Under certain conditions an increase of pressure can stabilize burning. Author

N65-13479 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE BURNING OF NITROGLYCERINE

K. K. Andreyev and G. N. Bespalov *In its* Theory of Explosives 31 Jan. 1964 p 610–626 refs (See N65-13451 04-33)

The effect of the diameter of the tube on the burning of nitro esters was investigated. In particular, the burning of nitroglycerine in liquid and gelatin nitrocellulose form, along with other nitro esters, was investigated in the pressure range of 0.01 to 100 atm. In the pressure range of 20 to 100 atm., the critical diameter for burning of the studied nitro esters decreased with an increase in pressure according to the relationship $d_c = A/p^n$, where n lies between 1.15 and 1.48. The transition from normal burning to turbulent conditions for liquids (nitroglycerine, nitroglycol) requires a large increase in the critical diameter of the tubes. Increasing the viscosity of nitroglycerine by dissolving in it a high polymer (nitrocellulose), decreased the rate of growth of the critical diameter (based upon the transition of burning to turbulent conditions) and, at sufficient viscosity, eliminated the growth. P.V.E.

N65-13480# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE BURNING OF MIXTURES OF INITIATING EXPLOSIVES AND LIQUID NITRO ESTERS

B. N. Kondrikov *In its* Theory of Explosives 31 Jan. 1964 p 627–644 refs (See N65-13451 04-33)

The influence of pressure on the character and burning rate of similar mixtures of explosives with different contents of azide was studied under conditions leading to the transition of burning into explosion. Liquid nitro esters (nitroglycol, nitroglycerine, and diglycoldinitrate) were used as secondary explosives. Lead styphnate and potassium picrate were also studied. The burning of the mixtures was found to be completely stable at high pressure. P.V.E.

N65-13481 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN REGULARITIES OF BURNING OF VOLATILE MULTICOMPONENT EXPLOSIVE SUBSTANCES

A. I. Gol'binder *In its* Theory of Explosives 31 Jan. 1964 p 645–661 refs (See N65-13451 04-33)

Volatile, multicomponent, liquid-explosive mixtures were burned in air at atmospheric pressure and room temperature. Mixtures of benzene and tetranitromethane, mixtures of nitrogen tetroxide and nitrobenzene, and liquid explosives slightly thickened by the dissolution of high molecular compounds were studied. The study indicated that it is the composition of the vapor and not the actual liquid composition which determines the burning possibility under given conditions, the speed of burning, and other characteristics of the process. Dilution of a mixture with water makes burning impossible as a result of the unfavorable composition of the vapor. With further dilution of the liquid with a ballast substance (oleum), burning becomes possible again. The phenomenon of fractional burnout in explosive mixtures was related to the composition of the vapor. P.V.E.

N65-13482 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COMBUSTION OF A HYPERGOLIC EXPLOSIVE MIXTURE AND ITS TRANSITION INTO DETONATION

A. I. Gol'binder *In its* Theory of Explosives 31 Jan. 1964 p 660–670 refs (See N65-13451 04-33)

The conditions leading from the combustion of hypergolic liquid explosives mixtures to detonation were investigated using mixtures of tetranitromethane and organic amines (aniline). The combustion of a self-ignited mixture changes to detonation if the height of the layer of liquid in the testtubes exceeds a certain critical magnitude; e.g., the height of the liquid layer, and not its total mass, is the critical condition for the transition of combustion to detonation. The essential role of the height of a liquid column in the transition of combustion detonation is explained as follows: In a self-ignited and burning mixture, reactions are continued between tetranitromethane and amine, as a result of which gases are formed. Gas bubbles rise to the surface of the liquid and cause a disturbance. The flow of gas over the surface of the liquid causes its intense dispersion and the formation of a rather thick layer of a gas-drop suspensions subsequent to the explosion, leading to the transition from combustion into detonation. P.V.E.

N65-13483# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE CAUSES OF INCOMPLETE DETONATION OF EXPLOSIVES IN BLAST HOLES

I. Ya. Petrovskiy and L. V. Volkov *In its* Theory of Explosives 31 Jan. 1964 p 671–698 refs (See N65-13451 04-33)

The incomplete detonation of blast hole charges was considered by investigation of the following: (1) the influence of the magnitude of the airgap between the faces of the blasting cartridges on the transmission of detonation; (2) the influence of the amount of bore meal between the blasting cartridges on the transmission of detonation; and (3) the incomplete detonation due to the presence of cartridge with lost detonation ability. Based on the results, tests are described which can be used to appraise the detonation properties of explosives in blast holes. P.V.E.

N65-13484 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE QUESTION OF FACTORS DETERMINING THE POSSIBILITY OF BURNING-OUT OF EXPLOSIVES IN BLAST HOLES

R. K. Andreyev and V. G. Khotin *In its* Theory of Explosives 31 Jan. 1964 p 699–704 refs (See N65-13451 04-33)

An explosive may burn out in a blast hole in a coal mine when the detonation wave stops and changes to a burning front. The slow-burning charge can later redetonate, causing injuries, and the burning charge then liberates poisonous gases. The ability of "ammonite" explosives (based on ammonium nitrate) to detonate is decreased by an increased density, while its ability to burn slowly is increased. The density of a charge is increased by packing and by compression during the initial phases of detonation. Two industrial explosives were tested for mechanical compressibility, relation of density to compression, detonation ability, and critical diameter of detonation. Two ways of preventing burning out are suggested: mixing substances into the explosive that obstruct packing, and replacing liquid sensitizers with solid ones. D.E.W.

N65-13485 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SELF-IGNITION OF LIQUID EXPLOSIVE MIXTURES

A. I. Gol'binder *In its* Theory of Explosives 31 Jan. 1964 p 705–728 refs (See N65-13451 04-33)

Subjects studied include the self-ignition of liquid mixtures of tetranitromethane with organic amines, the self-ignition of liquid mixtures based on concentrated nitric acid, and the flash of liquid explosive mixtures of tetranitromethane

with organic fuels during heating. It was experimentally established that up to the moment of ignition, warmup in the condensed phase of mixtures of tetranitromethane and organic amines is very small. Various possible factors in the ignition delay were investigated. When previously prepared intermediate products of the reaction between tetranitromethane and aniline are introduced, the delay time of self-ignition is sharply reduced. Self-ignition of liquid explosive mixtures before autoignition are strongly exothermic, and the liquid is intensely heated. The thermal ignition of mixtures including benzene, toluene, and dichlorethane was studied, and an upper limit of flash temperature was detected. D.E.W.

N65-13486# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INTENSITY OF FLASH IN EXPLOSIVE SUBSTANCES

B. N. Kondrikov *In its* Theory of Explosives 31 Jan. 1964 p 729–746 refs (See N65-13451 04-33)

The intensities of the thermal autoignition of different explosive substances were compared. A small, weighed amount of explosive was flashed in a heated test tube, on the mouth of which a ball lay. The height to which the ball bounced was used as a measure of intensity. Graphs are presented of intensity and delay of flash as functions of the temperature of the test tube for mercury fulminate, sodium picrate, lead picrate, tetrazene, pyroxylin, collodion in nitroglycerine, tetryl, trotyl, diglycoldinitrate, nitrogelatin (10% collodion), pentaerythritol tetranitrate (PETN), nitroglycerine, and nitroglycol. The effects of various gas mixtures over the explosives on the intensity and delay of flash were studied for PETN, diglycoldinitrate, nitroglycol, methylinitrate, pyroxylin, and nitroglycerine. D.E.W.

N65-13487 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE THERMOSTABILITY OF CRYSTALS OF EXPLOSIVES

K. K. Andreyev and V. V. Gorbunov *In its* Theory of Explosives 31 Jan. 1964 p 747–754 refs (See N65-13451 04-33)

A method of estimating the sensitivity of explosive crystals to thermal shock by heated gas was developed. The sensitivity to thermal shock of crystals of a number of explosives at furnace temperatures of 300° to 1100°C was determined. The most inclined to cracking are crystals of hexogene and potassium picrate. Crystals of trotyl, picric acid, and tetryl are not very sensitive to thermal shock. The influence of dimensions of crystals of TEN and hexogene on their sensitivity to thermal shock at a furnace temperature of 500° and 700°C was studied. With an increase of the dimensions of the original crystals, this sensitivity increases. The obtained data were compared to certain regularities that were observed upon transition of a burning explosive in a closed vessel to an explosion. Author

N65-13488 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE QUESTION OF TRANSITION OF BURNING OF EXPLOSIVES TO EXPLOSION

K. K. Andreyev *In its* Theory of Explosives 31 Jan. 1964 p 755–762 (See N65-13451 04-33)

A discussion is given of the main conditions necessary for the appearance of self-accelerated burning of powdery explosives and of the value of particle dimensions of powder explosives and certain other factors in the penetration of burning into the depth of a charge. Burning of explosives can penetrate into the depth of a powder charge if it occurs with great speed, which causes a dynamic increase of pressure on the surface of the charge, or if the explosive is ignited in a closed vessel, in which burning takes place under increasing pressure. The most favorable condition for transition of burning to explosion is the case when explosive particles are not too small, the gases penetrate deeply, and their heat is enough to ignite the entire initial surface. D.E.W.

N65-13492 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF SHELL ON THE DETONATION ABILITY OF CERTAIN DINITRO COMPOUNDS OF THE BENZENE SERIES

I. F. Blinov and L. M. Svetlova *In its* Theory of Explosives 31 Jan. 1964 p 779–789 refs (See N65-13451 04-33)

The influence of shells of various character on the brisance of certain dinitro compounds of the benzene series was studied. It was established that the smaller the detonation ability of a substance, the greater the influence exerted on the stability of detonation by the shell. The inertial resistance, strength, and compressibility exert a great influence on the detonation ability of the investigated substances. Author

N65-13493# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE INFLUENCE OF THE DIMENSIONS OF THE FOCUS OF INITIATION ON THE DETONATION ABILITY OF LOWLY-SENSITIVE EXPLOSIVES

I. F. Blinov and L. M. Svetlova *In its* Theory of Explosives 31 Jan. 1964 p 790–795 refs (See N65-13451 04-33)

Experiments conducted in an attempt to explain the following phenomenon are discussed: An initiator, which will stably detonate low-density powder charges of small diameter, cannot be used successfully with an analogous charge of large diameter because the detonation dies out. P.V.E.

N65-13494# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF SPEEDS OF SHOCK WAVES NECESSARY TO TRIGGER DETONATION OF EXPLOSIVES

G. G. Rempel' *In its* Theory of Explosives 31 Jan. 1964 p 796–815 refs (See N65-13451 04-33)

The speed of the initiating shock wave that must be created in a charge for detonation to appear depends on the charge diameter. For charges of critical diameter, $D_{init} = D_{crit}$. With an increase in diameter, D_{init} is decreased asymptotically, approaching the speed of sound in the substance. With deceleration of the detonation wave in trotyl charges, the length of zone of chemical reaction behind the wave front is increased. Accurate value of the critical rate detonation (speed at which a charge with a diameter equal to the critical detonates) can be determined by the point of intersection of curves of $D_{init} = f(d)$ and $D_{ch} = f(d)$. Author

N65-13537*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.

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F. E. Tippets and G. L. Converse 20 Oct. 1964 359 p refs (Contract NAS3-2528)

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Testing in the 300 kW loop at boiling temperatures up to 1700° F with helical inserts of both 2- and 5.5-inch pitch in a 1-inch nominal diameter tube was completed. The data obtained showed the helical insert to be very effective in extending the nucleate boiling regime, thus increasing heat-transfer performance. Modification of the 100-kW loop to increase the range and

control of experimental variables was completed. Development work on the radiant heater for the preboiler resulted in a coiled tungsten wire element design. A preheater was installed upstream of the throttling orifice to permit controlled flashing of the fluid at the orifice in order to extend the range of stable operation. Following installation of a new helical induction pump and modifications to improve potassium loop operability, the 50-kW loop was used in a series of tests with the 5/8-inch ID smooth tube test section. The feasibility of determining local static pressure in two-phase potassium flow by use of thermocouples in conjunction with published pressure–temperature data was established. R.L.K.

N65-13567# Ohio State U., Columbus. Aerodynamic Lab.
EQUILIBRIUM RADIATIVE HEATING AT SUPER-ORBITAL RE-ENTRY VELOCITIES
Robert M. Nerem [1964] 44 p refs Presented at the 15th Intern. Astronautical Cong., Warsaw, 7–12 Sep. 1964

The results of measuring radiation from high-temperature equilibrium air using an arc-driven shock tube facility were applied to the determination of reentry radiative heating at superorbital velocities. Although the results were found to be in wide disagreement with existing theoretical estimates at high temperatures and low densities where continuun radiation dominates the shock layer emission, they are in agreement with recent interpretations of radiative emission (such as the lower emission rate associated with de-ionization continuum radiation and the contribution of radiation by the N^- photoattachment process). A revised estimate of the radiance of high-temperature air is presented for use in engineering design calculations; this estimate indicates that, at high altitudes and at flight velocities in excess of the escape velocity from earth, the radiative heating encountered by a reentry vehicle will be less by a factor of two than that shown by existing theoretical calculations. D.S.G.

N65-13569# Stanford Research Inst., Menlo Park, Calif. Poulter Labs.
RESEARCH STUDY ON THE SURFACE INITIATION OF EXPLOSIVES Final Report
J. Roth 22 Mar. 1963 76 p refs
(Contract AF 29(601)-5134)
(AFSWC-TDR-63-49; AD-410851)

This study was undertaken to establish basic conditions for explosive systems capable of being initiated uniformly over their entire surface, and to demonstrate the functioning of the proposed system for simple geometries. The proposed system consists of PVA lead azide initiated by radiation from an argon flash bomb. In addition to lead azide, the suggested explosive train consists of PETN and Comp B. Uniformity of initiation in this train is good, but can be improved if lead azide in sheet form becomes available. Because sheet azide was unavailable, the applicability of the proposed system was not demonstrated for curved explosive surfaces, but it is believed that surface initiation of curved surfaces can be achieved. Author

N65-13873*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EFFECTIVENESS OF VARIOUS AGENTS FOR SUPPRESSING IGNITION OF RP-1 AND HYDROGEN UNDER FLOW CONDITIONS
J. B. Gayle and H. E. Tubbs Washington, NASA, Jan. 1965 43 p refs
(NASA-TN-D-2581)

Experimental studies were carried out to determine the quantities of helium, nitrogen, carbon dioxide, and/or trifluorobromomethane needed for suppressing ignition of mixtures of oxygen with RP-1 and hydrogen under conditions of turbulent flow in a 6-inch-diameter tube. The results indicated that on a weight basis the order of effectiveness of the various agents was $He >> N_2 > CF_3Br > CO_2$ for RP-1. For hydrogen, the order for the only two agents tested was $He >> N_2$. The quantities of agents required were large enough to preclude widespread in-flight applications. Author

N65-13874# Auburn U., Ala. School of Engineering
THERMAL CONDUCTIVITY: SUMMARY OF THE LINE-SOURCE METHOD AND THEORY OF HETEROGENEOUS MIXTURES, JULY–SEPTEMBER 1964
G. E. Tanger, G. H. Nix, S. C. Cheng, and G. W. Lowery Oct. 1964 43 p refs *Its* Rept. No.-X
(Contract DA-01-009-ORD-1023)
(NASA-CR-59821)

Improvements in the line-source method for determining thermal conductivity were completed. A critical analysis of the errors involved in the method was conducted. This analysis includes both an internal and external estimate of the errors involved. Automatic computation procedures were adapted for data reduction, permitting standardization of the method. Thermal-conductivity results obtained with the line-source method showed good consistency and reproducibility. A study has been initiated in determining the conductivity of heterogeneous materials. Solid propellants fall in this classification. Results from previous investigations are analyzed. Author

N65-13970 General Applied Science Labs., Inc., Westbury, N.Y.
AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF IGNITION AND AXISYMMETRIC TURBULENT FLAME PROPAGATION IN HYDROGEN-AIR MIXTURES AT SUPERSONIC SPEEDS
J. Tamagno and N. Trentacoste Jul. 1964 80 p refs
(Contract AF 49(638)-991)
(GASL-TR-445; AD-604429) OTS: $4.00

This report is an experimental study of turbulent combustion processes in high-speed flows, and the comparison of the experimental results with those obtained by means of a newly available numerical approach for the computation of flows with diffusion and finite rate chemistry. It is shown that stable ignition may be insured in a jet of hydrogen–air or ethylene–air mixture by a pilot flame of small dimensions and very low heat liberation compared to that of the main stream (of the order of 0.4%). Under proper conditions the premixed jet is ignited without fluctuations, periodic flashes or oscillations. A strong dependence of the flame propagation velocity on the mixture composition has been found experimentally for given constant flow conditions, i.e., flow velocity and total temperature of the mixture. This dependence correlated well with the predictions of the numerical computations. Author

N65-14078# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.
RESEARCH ON HEAT TRANSFER CHARACTERISTICS OF DIFFUSION BOUNDARY LAYERS Final Report No. 74
Judson R. Baron May 1963 16 p refs
(Contract AF 49(638)-245)
(MIT-DSR-8180; AD-411463)

The results are reported of experimental investigations of rarefied gases which show that the classical theory of gas dynamics in the Navier–Stokes approximation is correct for a wider range of conditions than that for which it was constructed. Some results are presented of investigations into the phenomena of slip and temperature jump, which are associated with the transfer of momentum and energy in the boundary layer of a rarefied gas. Author

N65-14091# Stanford U., Calif.
DIRECT ENERGY CONVERSION SYSTEMS. SUPPLEMENT I: HEAT AND MASS TRANSFER FROM THE SURFACE OF A CYLINDER WITH DISCONTINUOUS BOUNDARY CONDITIONS TO AN INCOMPRESSIBLE LAMINAR FLOW Quarterly Technical Summary Report, 1 Jun.–31 Aug. 1964
Zeev Rotem 30 Sep. 1964 71 p refs
(Contract AF 49(638)-1123; ARPA Order 246)
(AD-609416)

Heat and mass transfer studies for flow over a cylinder having a longitudinal-strip source of heat or mass, are presented. A theory for the two asymptotic cases of $Pr \to \infty$ and $Pr \to 0$ is developed, giving the temperature profile and the transfer rate for such a strip. The theory includes the effect of the conductivity of the heating strip material. It is shown that if the conductivity of the strip material is very high, then the transfer rate is a measure of local wall shear–stress provided the Prandtl number of the convecting fluid is high. Experimental studies described include electrochemical mass-transfer studies carried out on a rotating cylindrical electrode carrier; and heat transfer studies carried out in an oil tunnel. Fair correlation between theory and experiment was found. Author

N65-14221# AVCO-Everett Research Lab., Everett, Mass.
NITROGEN AND AIR RADIATION IN THE NEAR IR
Kurt L. Wray and Thomas J. Connolly Nov. 1964 24 p refs
(Contract DA-19-020-AMC-0210; ARPA Order 525; Proj. Defender)
(AVCO-Everett Res. Rept.-200; AD-450966)

Equilibrium radiation from shock heated nitrogen and air was monitored with calibrated photomultipliers at 0.72μ (band pass = 0.14μ) and 1.0382μ (band pass = 0.0066μ). The initial pressure in the shock tube was varied from 1 to 10 torr and the temperature range covered was from 4700 to 6500° K. For the N_2 runs, the radiation arises from the $N_2(1+)$ band system, and the data yield f-numbers of $f = 8.3 \times 10^{-3}$ at 0.72μ and $f = 3.4 \times 10^{-3}$ at 1.04μ. In the air case, there is more radiation than can be accounted for by the sum of the radiation arising from the $N_2(1+)$ and the other known sources—the $NO + O \rightarrow NO_2 + h\nu$ and O^- free-bound continua. At 0.72μ, the air radiation was about three times that accounted for, while at 1.04μ it was about seven times that accounted for. The lack of correct pressure scaling and the anomalously high apparent f-numbers obtained from this data cast doubt on the assignment of this excess air radiation to NO, as has been done by other workers. Author

N65-14303# Purdue U., Lafayette, Ind.
STUDIES IN HYBRID COMBUSTION Final Summary Report, 8 Jan. 1962 – 17 Jan. 1964
R. J. Zabelka and D. F. Brink Sep. 1964 245 p refs
(Contract N123(60530)29155A)
(NAVWEPS-8541; NOTS-TP-3550; AD-608106)

Studies were conducted in laboratory-scale burners to determine the influence of experimental parameters on the combustion, with gaseous oxygen, of hybrid hydrazine fuels and Plexiglas. With hydrazine gel, the burning rate was limited by heat transfer from the flame to the surface of the fuel. With cross-linked hydrazine gel, kinetics of surface degradation reactions—at least at high oxidizer mass flux—was the controlling factor. With aluminized cross-linked hydrazine gel, the factors were more complex. With Plexiglas, the heat transfer from the flame to the surface for low values of mass flux and kinetics of surface degradation reactions for high values of mass flux were predominant factors. The burning rate was affected by the chamber pressure largely through influence on the density of the gases and by the design of the combustion chamber and injector through their effect on oxidizer mass flux in the vicinity of the fuel surface. Author

N65-14342# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF HEAT EXCHANGE IN ROUND PIPES DURING SUPERSONIC GAS FLOW
V. M. Polyayev and S. V. Belov 28 May 1964 14 p refs
Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mashinostro. (Moscow), No. 5, 1963 p 92–99
(FTD-MT-64-58; AD-606739) OTS: $1.00

Results are reported of the experimental investigation of heat exchange in round pipe during the supersonic flow of gas, and comparisons are given of experimental data with results of calculation by existing criterial dependences. It is established that the coefficient of heat transfer in round pipes at low values of temperature factor and M numbers to 2.7 can be determined by generalized criterial dependences. Author

N65-14364# Naval Civil Engineering Lab., Port Hueneme, Calif.
NEAR-INFRARED ATTENUATING FLUIDS
E. Lumsdaine 15 Oct. 1964 31 p refs
(N-646; Y-R011-01-01-026; AD-450573)

The attenuation of near-infrared radiation by a spray of water droplets with and without additives was studied experimentally by varying droplet size and flow rate. Three distinct droplet size distributions were used; each distribution was tested with three different flow rates. The data were evaluated in terms of relative effectiveness of a spray of droplets of pure water as compared to water containing additives. Four additives were used: Ponolith, a black organic dye; Amberlite, an ion exchange resin; KWK Vorclay; and aluminum powder. The first three were selected for their property of decreasing the transmission windows of water when tested in the spectrometer; the aluminum powder was tested in the spray for its backscattering effect. The experimental results are compared with a theoretical study of absorption and scattering of radiation by large particles. An approximation technique is used to determine the absorptivity of water with and without additives. Author

N65-14448*# Purdue U., Lafayette, Ind. Jet Propulsion Center
ENERGY TRANSFER FROM A LIQUID TO GAS BUBBLES FORMING AT A SUBMERGED ORIFICE
M. R. l'Ecuyer and S. N. B. Murthy Washington, NASA, Jan. 1965 187 p refs
(Grant NsG-140-61)
(NASA-TN-D-2547) OTS: HC $5.00/MF $1.25

An experimental and analytical study was conducted to determine the rate of energy transfer from a relatively hot liquid to a relatively cool gas injected into the liquid through a submerged orifice, resulting in the periodic formation of discrete gas bubbles at the orifice. A preliminary investigation indicated that a significant amount of energy transfer occurs during the time of formation of the bubbles. Consequently, this investigation is concerned with the determination of the energy transfer from the liquid to the gas bubbles during the period of formation of the bubbles at the orifice. Experiments were conducted with dry nitrogen gas injected into distilled water and ethyl alcohol. The dry nitrogen gas was injected through single orifices having diameters of 0.159 and 0.079 cm, with dry nitrogen mass flow rates ranging from 2.25×10^{-3} to 12.7×10^{-3} gm/sec. The overall temperature difference between the liquid and the injected gas, which was produced by precooling the gas, was approximately 155C. The change in temperature of the injected gas during the period of bubble formation was observed to be 55% to 90% of the overall temperature difference. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-13351 Queens U., Belfast (Northern Ireland).
RESEARCH ON PHYSICS OF THE UPPER ATMOSPHERE Technical (Final) Report
D. R. Bates, A. Dalgarno, B. L. Moiseiwitsch, A. L. Stewart, A. H. Jarrett et al 30 Jun. 1964 71 p refs
(Grant AF-EOAR-63-85)
(AFCRL-64-876; AD-608484)

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2. TEMPERATURE OF OI ATOMS RESPONSIBLE FOR THE 6300 Å OI EMISSION OF THE NIGHTGLOW p 8–10 refs (See N65-13353 04-13)
3. THE 6300 Å OI DAYGLOW EMISSION p 11–13 refs (See N65-13354 04-13)
4. VARIATIONS OF HYDROXYL AND OXYGEN EMISSIONS IN THE INFRA-RED AIRGLOW p 14–15 (See N65-13355 04-13)
5. INFRA-RED INVESTIGATIONS OF THE NIGHT SKY USING A MICHELSON INTERFEROMETER p 16–18 refs (See N65-13356 04-13)
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10. SEMI-EMPIRICAL EFFECTIVE POTENTIALS FOR USE IN ATOMIC, MOLECULAR AND SOLID-STATE PROBLEMS p 42–46 refs (See N65-13361 04-24)
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N65-13376# Oak Ridge National Lab., Tenn.
PROCEEDINGS OF 1963 HIGH-TEMPERATURE LIQUID-METAL HEAT TRANSFER TECHNOLOGY MEETING
Dec. 1964 388 p Meeting held at Oak Ridge Natl. Lab., 4–6 Sep. 1963; sponsored by AEC
(Contract W-7405-ENG-26)
(ORNL-3605, Vol. 2) OTS: $7.00

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4. HEAT TRANSFER AND PRESSURE DROP CHARACTERISTICS FOR BOILING RUBIDIUM IN FORCED CONVECTION (Aerojet-Gen. Nucleonics) C. R. Fisher p 64–85 refs (See N65-13380 04-33)
5. ALKALI METALS BOILING AND CONDENSING INVESTIGATIONS J. Longo, Jr. and R. D. Brooks (Gen. Elec.) p 86–109 refs (See N65-13381 04-33)
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12. SELECTED PARAMETERS FOR TWO-PHASE FLOW OF SODIUM K. Goldmann (United Nuclear Corp.) p 270–292 refs (See N65-13388 04-12)
13. STABILITY OF PARALLEL-PATH TWO-PHASE FLOW T. J. Vild and D. E. Sill (Thompson Ramo Wooldridge p 293–315 refs (See N65-13389 04-12)
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N65-13577# Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Chemical Propulsion Information Agency
BULLETIN OF THE 3RD MEETING, INTERAGENCY CHEMICAL ROCKET PROPULSION GROUP, WORKING GROUP ON MECHANICAL BEHAVIOR, VOLUME I
Oct. 1964 606 p refs Meeting held at Army Missile Command, Redstone Arsenal, Ala., 17–19 Nov. 1964
(Contract NOw-62-0604-c)
(CPIA Publ. 61U; AD-451712)

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4. TWO-DIMENSIONAL STRESS ANALYSIS OF SOLID PROPELLANT ROCKET GRAINS E. L. Wilson (Aerojet-Gen Corp.) p 9–26 refs (See N65-13578 04-27)

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15. APPLICATION OF FINITE ELASTIC THEORY TO PROPELLANT BEHAVIOR J. A. Rinde and N. Fishman (Stanford Res. Inst.) p 177–190 refs (See N65-13589 04-27)

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37. THE STRESS DISTRIBUTION IN AN INFINITE ELASTIC SOLID PERFECTLY BONDED TO TWO UNEQUAL RIGID SPHERICAL INCLUSIONS J. L. Hill (Ala. U.) p 591–606 refs (See N65-13611 04-32)

38. RADIAL STRESS MEASUREMENTS IN PROPELLANT GRAINS A. San Miguel and R. H. Silver (JPL) p 607–623 refs (See N65-13612 04-14)

N65-13800# Joint Publications Research Service, Washington, D.C.

NEWS OF MOSCOW STATE UNIVERSITY

I. G. Petrovskiy 16 Dec. 1964 24 p Transl. into ENGLISH from Pravda (Moscow), 13 Sep. 1964 p 3 (JPRS-27878; TT-64-51953) OTS: $1.00

Presented are various articles that originated from the Moscow University. The first gives an overall view of the work and organization at the university. The second paper

describes a tectonic map of Europe that shows all zones with active magnetic processes, a metallogenic map, and a petroleum and natural gas distribution map from the U.S.S.R. The third study pertains to the creation of synthetic high-molecular compounds through polymerization and the structural peculiarities of polymer materials. The fourth article describes the variety of research that is pursued by the Department of Organic Chemistry at Moscow University. The fifth study discusses superhigh as well as low-energy particles. In the final article, various innovations are presented that were introduced into productive processes. G.G.

N65-13892# Joint Publications Research Service, Washington, D.C.
IZVESTIYA VUZov: RADIOPHYSICS, VOLUME VII, NUMBER 3, 1964
25 Nov. 1964 307 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz., v. VII, no. 3, May–Jun. 1964 p 395–578
(JPRS-27545; TT-64-51794) OTS: $6.00

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N65-14459*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
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